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CONTENTS

PAGE

1. HOMONYMS IN THE PRODROMI OF THUNBERG AND BURMAN. J. E. DANDY..... 427

2. SOUTH AFRICAN LABIATAE. L. E. CODD..... 429

3. SOUTH AFRICAN SPECIES OF SATUREIA. D. J. B. KILLICK..... 435

4. ×RUTTYRUSPOLIA, A NATURAL INTERGENERIC HYBRID IN ACANTHACEAE. A. D. J. MEEUSE AND J. M. J. DE WET..... 439

5. NOTES AND NEW RECORDS OF AFRICAN PLANTS..... 443

   ACANTHACEAE. A. D. J. MEEUSE AND A. A. OBERMEYER.

   APOCYNACEAE. L. E. CODD.

   ARACEAE. CYTHNA LETTY.

   EBENACEAE. B. DE WINTER.

   GENTIANACEAE. I. C. VERDOORN AND W. MARAIS.

   GESNERIACEAE. R. STORY.

   GRAMINEAE. B. DE WINTER.

   HYPOXIDACEAE. D. J. B. KILLICK.

   LILIACEAE. A. A. OBERMEYER.

   MALVACEAE. A. D. J. MEEUSE.

   PLUMBAGINACEAE. R. A. DYER.

   SCROPHULARIACEAE. O. OVERKOTT.

   TURNERACEAE. R. STORY.

6. THE VIRUS DISEASES OF CROTALARIA, GLYCINE AND MEDICAGO SPECIES. PATRICIA J. KLESSER..... 497

7. THE VIRUS DISEASES OF BEANS. PATRICIA J. KLESSER..... 521

8. A CONTRIBUTION TO OUR KNOWLEDGE OF THE FRESHWATER ALGAE OF THE TRANSVAAL PROVINCE. M. I. CLAASSEN..... 559

9. REVIEW OF THE FLORA ZAMBESIACA, VOL. I, PART 1, 1960. L. E. CODD..... 667

10. ADDENDUM: CLADOPHORA ISAACII R. H. SIMONS..... 668

Homonyms in the Prodromi of Thunberg and Burman

by

J. E. Dandy

I was asked by the Division of Botany, Pretoria, to give an opinion concerning the status of the name *Cestrum venenatum* used by Thunberg in his *Prodromus* (1794), the question being whether this was intended to be the name of a new species, or whether Thunberg was simply adopting the already existing name *C. venenatum* Burm. f. (1768). The two works concerned are Thunberg's *Prodromus Plantarum Capensium* (1794, 1800) and N. L. Burman's *Florae Capensis Prodromus* appended to his *Flora Indica* (1768). Investigation of these showed that there are a number of cases similar to that of *Cestrum venenatum*, and I therefore thought it advisable, before forming an opinion, to carry out a comparative analysis of all the specific names published in the two *Prodromi*. Following are the results.

Thunberg dedicated his *Prodromus* to N. L. Burman but this is apparently a mark of appreciation of and gratitude for help and encouragement given by Burman, *not* a reference to Burman's own published work on the Cape flora. In fact Thunberg nowhere in his *Prodromus* makes any direct reference to Burman's *Prodromus*, and the only mention of N. L. Burman in the text is on p. 108 where he is cited under *Heliophila* in connexion with a description of that genus published in a Swedish journal. The other references to " Burm." given by Thunberg (e.g. on pp. 97, 98) are to the pre-Linnaean work of J. Burman, the elder. On the other hand, Thunberg throughout his *Prodromus* cites various Linnaean works, with which he was obviously familiar, and also makes occasional references to post-Linnaean publications by Bergius, L'Héritier, Sparrman, Cavanilles, Smith, Jacquin, Delaroche, Houttuyn and Acharius (lichens).

N. L. Burman in his *Prodromus* published about 260 legitimately named new species from the Cape, usually providing a description of his own but sometimes citing an earlier one. It is noteworthy that only 22 of the names listed by Thunberg correspond (in form, at least) with new specific names published by Burman in his *Prodromus*. They can conveniently be listed as follows, each with the Thunberg page-number and then the Burman page-number in parentheses:

Gladiolus junceus 8 (2)
Echium spicatum 33 (4)
Erica hispida 70 (11)
Ononis prostrata 129 (21)
Othonna linifolia 167 (29)
Satyrium cornutum 5 (30)
Polygala stipulacea 121 (20)
Lobelia volubilis 39 (29)
Aloe arachnoides 61 (10, " *arachnoidea* ")
Schoenus spicatus 16 (3)
Echium hispidum 33 (5)
Cestrum venenatum 36 (5)
Vitis capensis 44 (7)
Limeum aethiopicum 68 (11)
Reseda capensis 85 (13)
Orobanche capensis 97 (17)
Geranium ovale 113 (19)
Ononis strigosa 130 (21)
Phaseolus capensis 130 (21)
Psoralea linearis 135 (22)
Gnaphalium spathulatum 151 (25, " *spatulatum* ")
Osteospermum incanum 166 (29)

Of these, *Gladiolus junceus* is *G. junceus* L. f. (1781), non Burm. f.; *Echium spicatum* is *E. spicatum* L. f. (1781), non Burm. f.; *Erica hispida* is *E. hispida* Thunb. (1785), non Burm. f.; *Ononis prostrata* is *O. prostrata* (L.) L. (1771), non Burm. f.; *Othonna linifolia* is *O. linifolia* L. f. (1781), non Burm. f. *Satyrium cornutum* is *S. cornutum* (L.) Thunb., a new combination based on *Orchis cornuta* L., which has no connexion with *S. cornutum* Burm. f. *Polygala stipulacea* is evidently taken up from Linnaeus, Mant. Pl. Alt. 260 (1771), where Linnaeus makes an interpretation of *P. stipulacea* Burm. f. Similarly *Lobelia volubilis* is taken up from Linnaeus fil., Suppl. Pl. 396 (1781), where an interpretation is made of *L. volubilis* Burm. f. *Aloe* " *arachnoides* " is *A. arachnoidea* (L.) Burm. f., this being Linnaeus's *A. pumila* var. *arachnoidea* which was raised to specific rank in 1768 both by Burman and (probably later) by Miller, Gard. Dict., ed.8; the spelling *A.* " *arachnoides* " was used by Thunberg in one of his earlier works (Diss. Bot.-med. Aloe, 7) in 1785.

Thus only the 13 names in the right-hand column above have to be considered, and it is at once notable that they all have common-place epithets which might occur to any author coining names for new species. Furthermore, Thunberg's descriptions of these species all differ more or less from those given (or referred to) by Burman for his species, and while Thunberg was in the habit of remodelling descriptions (even for Linnaean species) the differences in some cases are so striking that it is difficult to believe that he is referring to Burman's species. For example:

Psoralea linearis Burm. f.: " foliis simplicibus . . . floribus terminalibus ternis ".
Psoralea linearis Thunb.: " foliis ternatis . . . floribus lateralibus solitariis ".

Ononis strigosa Burm. f.: " floribus axillaribus sessilibus ".
Ononis strigosa Thunb.: " umbellis terminalibus ".

Limeum aethiopicum Burm. f.: " foliis ovato oblongis ".
Limeum aethiopicum Thunb.: " foliis lineari-lanceolatis ".

From the above we have the following points:

(1) Thunberg nowhere refers directly to Burman's *Prodromus*.

(2) Only very few of Thunberg's names coincide with names proposed by Burman and not used by any other author.

(3) Of these few, all have common-place epithets and all have descriptions differing (sometimes fundamentally) from Burman's.

My conclusion is that none of Thunberg's names (except *Polygala stipulacea*, and *Lobelia volubilis* which he adopted through Linnaean works) can be accepted as an application of a new Burman name; and that all the names listed in the right-hand column above, including *Cestrum venenatum*, are to be regarded as illegitimate later homonyms published as new by Thunberg.

South African Labiatae

by

L. E. Codd

THORNCROFTIA

The genus *Thorncroftia* was described by N. E. Brown in Kew Bull. 1912:281 and was based on *T. longiflora* N.E.Br., which he described at the same time. Only one specimen was cited, namely: " Transvaal, among rocks near Barberton, 1220 m, *Thorncroft* 795". Two specimens in the Transvaal Museum Herbarium (now incorporated in the National Herbarium, Pretoria), collected by George Thorncroft, supply additional information. On No. 795 the label states: " Herb, 2 ft., flowers pink, found among sandstone rocks, Joe's Luck near Barberton, alt. 4,000 ft., April 1911 "; and on a second gathering without number: " Joe's Luck footpath near Barberton, on sandstone rocks, alt. 4,000 ft., May 1913 ".

The only other material of the species known until recently is a plant cultivated by the Cambridge Botanic Garden from seed sent by Thorncroft, and figured for the Botanical Magazine, t. 8824 (1919). In order to evaluate the plant as to generic status, it was felt that more material was required and the assistance was enlisted of Barberton residents, including George Thorncroft's son, Mr. J. N. Thorncroft, and grandson, Mr. N. G. Thorncroft.

In George Thorncroft's time a flourishing settlement existed in the mountains some miles to the north-east of Barberton, called Eureka City, which boasted of amenities attractive to inhabitants of the neighbourhood. Joe's Luck is the name of a mine nearby and a railway siding in the low country at the foot of the mountains, and it is reported that a well-used footpath connected the latter with Eureka City some 2,000 feet higher in altitude. At present, however, very little is left of Eureka City and the footpath cannot be traced with certainty. Thus more than a year passed before Mr. and Mrs. P. F. Clarke and Mr. N. G. Thorncroft found the species in the mountains above Joe's Luck Siding, probably not far from the type locality.

During their searches in the environs of Barberton, Mr. and Mrs. Clarke collected two species which were clearly closely allied to *Thorncroftia longiflora*, and one of these was again collected near Barberton by the late Prof. Werdermann of Berlin, during his recent visit to South Africa. Further study revealed that these two species had been described in the genus *Plectranthus*, as *P. thorncroftii* S.Moore and *P. succulentus* Dyer and Bruce. The opportunity is now taken to transfer them to *Thorncroftia*.

Although the three species now in *Thorncroftia* superficially resemble *Plectranthus* or *Orthosiphon*, they possess characters which clearly place them in a distinct genus. These characters are: (*a*) the flowers are borne singly in the axils of the bracts, not in several-flowered verticils; (*b*) the bracts are not clearly differentiated from the leaves, but grade into the upper leaves on the flowering shoot; and (*c*) the corolla, although obscurely bilabiate is, in fact, 4 lobed, comprising a lower, entire, boat-shaped lip, an erect upper emarginate lobe and two lateral, narrowly oblong lobes which are deflexed in the open flower and spread on each side of the lower lip. This may represent a more primitive state than in *Plectranthus* and *Orthosiphon*, where the lateral lobes are apparently fused with the upper, producing a more or less obscurely 4-lobed upper lip, while the lower boat-shaped lip remains much the same.

In some minor respects the generic description of *Thorncroftia* must be modified to accommodate the two additional species. For instance, the upper calyx lobe may or may not be decurrent on the tube, and the corolla tube may be short or long.

The basic chromosome number in *Thorncroftia* appears to be n = 7, as in *Plectranthus* and *Orthosiphon*, judging by the number 2n = 28 recorded for *T. succulentus* by de Wet in S.A. Journ. Sci. 54:153 (1958). Another point of general interest is that the three species of *Thorncroftia* are almost invariably parisitised by a weevil, *Apion* sp., which causes thickened swellings in the succulent stems. It is not known how specific this weevil is, but very rarely are *Plectranthus* specimens seen with these swellings and *Orthosiphon* not at all.

Plants up to 25 cm tall; corolla tube less than 1 cm long..... 1. *T. thorncroftii.*

Plants 30–120 cm tall; corolla tube 1·5–3·8 cm long:

Inflorescence relatively lax; corolla tube 3·4–3·8 cm long; pubescence consisting of simple or multicellular, not dendroid hairs..... 2. *T. longiflora.*

Inflorescence compact; corolla tube 1·5–2 cm long; dendroid hairs present, mixed with simple and multicellular straight hairs..... 3. *T. succulentus.*

1. **T. thorncroftii** (*S. Moore*) *L. E. Codd*, comb. nov.
Plectranthus thorncroftii S. Moore in Journ. Bot. 56:39 (1918). Type: Barberton, *Thorncroft* in Rogers 16987 (BM, holo., PRE, iso.). On the PRE specimen the number has been altered to 14987.

Succulent herb 10–25 cm high; stem erect, sparingly branched, about 8 mm in diameter at the base, tapering to 4 mm in diameter above, pubescent with glandular, simple and scattered multicellular hairs. *Leaves* opposite, shortly petioled, obovate to oblong-obovate, 1·5–2 cm long and 6–8 mm broad, fleshy, drying subcoriaceous, thinly pubescent and glandular on both surfaces, cuneate at the base, apex rounded; margin sparingly crenate-dentate in the upper third; pubescence mainly of multicellular, unbranched hairs. *Inflorescence* a raceme or sparingly branched panicle 5–8 cm long; bracts opposite, leaflike, up to 6 mm long below, becoming progressively smaller and narrower above to about 3 mm long; flowers solitary in the axil of each bract, pedicels 3–6 mm long, glandular puberulous. *Calyx* 5-toothed, glandular puberulous, obscurely 2-lipped, 3–3·5 mm long in flowering stage increasing to 7 mm long in fruit, tube campanulate; the upper tooth the largest, ovate-deltoid, decurrent on the tube, the lower 4 subequal, lanceolate- to linear-triangular. *Corolla* whitish with purplish spots on the upper lobe, obscurely bilabiate, sparingly pubescent without; tube campanulate, expanding abruptly from the calyx, 4·5–5 mm long and 2·5–3 mm broad; upper lip erect, sub-orbicular, emarginate, 6 mm long and equally broad; two lateral lobes oblong, 3–4 mm long, deflexed; lower lip boat-shaped horizontal, 6–7 mm long. *Stamens* 4 exserted; filaments free, up to 6 mm long. *Ovary* 4-lobed, glabrous; style slender, exserted; stigma shortly bifid.

Found among rocks in mountain grassland. Known so far only from the mountain massif between Barberton and Havelock Mine.

Transvaal.—Barberton: *Thorncroft* in Hb. Rogers 16987 (or 14987); Havelock road, growing among rocks and grass on koppie near Angle Station, alt. 5,000 ft., 24th March, 1956, *Clarke* 41; between Barberton and Piggs Peak, *Werdermann* 2197.

This species has a short corolla tube and the corolla bears a superficial resemblance to certain species of *Plectranthus*, e.g. *P. thunbergii*, as remarked by Spencer Moore. However, it has the essential features of *Thorncroftia*, namely the four-lobed corolla, solitary flowers in the axils of the bracts and the rather leaflike bracts. The upper calyx tooth is decurrent on the tube as in *Orthosiphon*.

2. **T. longiflora** *N.E.Br.* in Kew Bull. 281 (1912); Prain in Bot. Mag. t.8824 (1919).
Type: Transvaal, Barberton, *Thorncroft* 795 (K, holo., PRE, iso.).

Succulent herb or soft shrublet 30–60 cm high; stems several, arising from a thickened rootstock about 4 cm in diameter, 1 cm in diameter at the base, tapering to 4–5 mm in diameter above, sparingly branched, densely and shortly grey tomentose;

pubescence of simple and multicellular unbranched hairs. *Leaves* opposite, shortly petiolate, elliptic to obovate, 1–2 cm long and 4–10 mm broad, cuneate at the base, apex rounded, entire or faintly crenate-dentate in the upper third, densely short tomentose and pitted with sessile glands on both surfaces. *Inflorescence* a panicle; racemes 3–9 cm long, densely glandular puberulous; bracts opposite, leaflike, up to 1·2 cm long below, becoming progressively smaller and narrower above to about 2·5 mm long; flowers solitary in the axil of each bract; pedicels 2·5–4 mm long, glandular puberulous. *Calyx* 5-toothed, glandular puberulous, obscurely 2-lipped, the upper tooth the largest, ovate-deltoid, acute, decurrent on the tube, the lower 4 subequal, lanceolate-triangular, acuminate. *Corolla* pink to mauve pink with deeper flecks on the lateral lobes, obscurely bilabiate, glandular and sparingly pubescent without; tube narrowly cylindrical, straight, 3·4–3·8 cm long and 1–1·5 mm broad; upper lip erect, oblong, emarginate, 7–8 mm long and 4–5 mm broad; two lateral lobes narrowly oblong 5–6 mm long and 1·5 mm broad, deflexed; lower lip narrowly boat-shaped, horizontal, 6–7 mm long. *Stamens* 4, exserted; filaments free, 6–7 mm long. *Ovary* 4-lobed, glabrous, style slender, exserted; stigma shortly bifid.

Found in crevices on relatively bare rock outcrops. Evidently rare and localised in mountains north-east of Barberton.

Transvaal.—Barberton: Joe's Luck footpath, April, 1911, *Thorncroft* 795; May, 1913, *Thorncroft* in TM 12775; March, 1957, *Thorncroft and Clarke* s.n.

3. **T. succulentus** (*Dyer and Bruce*) *L. E. Codd*, comb. nov.
Plectranthus succulentus Dyer and Bruce in Flow. Pl. Afr. 27:t.1073 (1949). Type: Soutpansberg, Entabeni, *Loock* in PRE 27461 (PRE, holo.).

Succulent herb or shrub 60–120 cm high; stems several arising from a thickened rootstock 3–6 cm in diameter, 0·7–1·5 cm in diameter at the base and tapering to 4–5 mm in diameter above, sparingly branched, densely and shortly grey tomentose. *Leaves* opposite, shortly petiolate, ovate-elliptic or obovate 1·6–3 cm long and 1·5–2 cm broad, cuneate or obtuse at the base, apex rounded, crenate in the upper two-thirds, thinly to densely tomentose and glandular on both surfaces; pubescence consisting of branched and unbranched multicellular or simple white hairs. *Inflorescence* a congested racemose panicle 8–14 cm long, glandular and hispid with dendroid hairs; racemes 2·5–4 cm long; bracts opposite, somewhat leaflike, ovate and 1·2 cm long below, becoming progressively smaller and narrower above to about 5 mm long and 2–3 mm broad; flowers solitary in the axil of each bract; pedicels 0·5–2 mm long, pubescent. *Calyx* 5-toothed, with scattered glands and dendroid hairs, obscurely 2-lipped, the upper tooth somewhat larger than the rest, ovate-deltoid, acuminate, not obviously decurrent on the tube, the lower 4 subequal, lanceolate-triangular, acuminate. *Corolla* pale lilac with darker spots on the upper and lateral lobes, obscurely bilabiate, glandular and sparingly pubescent without; tube narrowly cylindrical, straight, 1·5–2 cm long and 1·5–2 mm in diameter; upper lip erect, obovate-oblong; emarginate, 6–8 mm long and 5–7 mm broad; two lateral lobes narrowly oblong, 5–6 mm long and 1 mm broad, deflexed; lower lip narrowly boat-shaped, 5–6 mm long, at first horizontal and later reflexed. *Stamens* 4, exserted; filaments free, 3–4 mm long. *Ovary* 4-lobed, glabrous; style slender, exserted; stigma shortly bifid.

Occurs among rocks or in crevices of bare rock outcrops in mountains of eastern and northern Transvaal.

Transvaal.—Soutpansberg: Soutpansberg Mountains, Entabeni, *Loock* in PRE 27461; *Bruce and Kies* 7; *Codd* 4194; Summit of Franzhoek Peak, *Galpin* 14881; Hangklip, *Gerstner* 5903; *McKay* s.n.; *Meeuse* 10163; 20 miles W. of Mountain Inn, *Meeuse* 9787; Wylliespoort, *Breyer* in TM 19451. Pilgrimsrest: Drakensberg escarpment opposite Mariepskop, *Codd* 7904. Barberton: Hyslop's Creek, *Clarke* 213.

Coleus neochilus (*Schltr.*) *L. E. Codd*, comb. nov.

Plectranthus neochilus Schltr. in J. Bot. Lond. 34: 394 (1896); Cooke in Fl. Cap. 5, 1: 285 (1910). Type: Transvaal, near Barberton, *Galpin* 968 (GRA, NH, iso.).

Coleus schinzii Guerke in Bull. Herb. Boiss. 6: 555 (1898); Bak. in Fl. Trop. Afr. 5: 430 (1900). Type: S.W. Africa, Ovamboland, Tsumeb, *Schinz* 56 (Z, holo., PRE, photo.). *C. pentheri* Guerke in Ann. Naturhist. Hofmus. Wien, 20: 48 (1905); Cooke in Fl. Cap. 5, 1: 289 (1910); Bruce in Hook. Ic. Pl. 34: t.3375 (1938). Type: Cape Province, Peddie District, Breakfast Vlei, *Krook* in Hb. Penther 1716 (W, holo., PRE, iso.). *C. carnosus* Dinter, ined.; Eliovson, S.A. Flow. for the Garden, 165 (1955) nom. nud.; non Hassk. nec A. Chev.

Found in relatively dry bushveld, or occasionally among rocks in moister grassland, in the eastern Cape Province, Natal, Transvaal, S.W. Africa and Rhodesia.

Cape.—Peddie: Breakfast Vlei, *Krook* in Hb. Penther 1716. East London: Kintza River Mouth, *Galpin* 6554. Stutterheim: Kabaku Hills, *Acocks* 9547. Komgha: *Flanagan* 557.

Natal.—Pietermaritzburg: Thornville Junction, *Chapman* 1368. Weenen: 1 mile W. of Muden, *Codd* 8602.

Transvaal.—Carolina: Waterval Boven, *Rogers* 14485. Barberton: near Barberton, *Galpin* 968 (GRA, NH); *Codd* 9531; on Lebombo Range, near Kobinja, *Codd* 7798. Pilgrim's Rest: near Graskop, *Galpin* 14433; near Vaalhoek, *Meeuse* 10013. Lydenburg: Sekukuniland, *Barnard and Mogg* 704. Pietersburg: *Munro* in TM 15282. Potgietersrus: *Rogers* 4817; *Comins* 917. Waterberg: Towoomba Research Station, *Sidey* 1401. Pretoria: Rietvlei Research Station, *Acocks* 11262; 13 miles S.E. of Pretoria, *Codd* 2570; Quaggapoort, *Verdoorn* s.n.; near Saltpan, *Pole Evans* 4775; 10½ miles N. of Hammanskraal, *Codd* 9385. Rustenburg: 19 miles S. of Northam, *Codd* 8632. Marico: near Zeerust, *Jenkins* in TM 13219; *Leistner* 349. Lichtenburg: *Jenkins* in TM 13220; *Sutton* 365.

S.W. Africa.—Ovamboland: Tsumeb, *Schinz* 56 (Z). Grootfontein: *Schoenfelder* S643; near Otavi, *Dinter* 5634; *de Winter* 2853.

S. Rhodesia.—Intabazinduna Reserve, *Davies* 19. Inyanga Village, *Wild* 3853. Matobo: Bulawayo, *Rogers* 5933; 13657; Bima Kobila, *Miller* 2054; Matopos Research Station, *Plowes* 1388. Mrewa: near Shawanoe, *Leach* 8084.

I am indebted to the Director of the Natural History Museum, Vienna, for presenting the National Herbarium, Pretoria, with a portion of the type of *C. pentheri* Guerke, and to the Director of the Zurich University Herbarium for sending us the type of *C. schinzii* Guerke on loan. These were compared with material of the type gathering of *Plectranthus neochilus* Schltr. (*Galpin* 968 in NH and GRA) and are considered to be conspecific. The differences between the three types are mainly in habit and pubescence, characters which vary a good deal in this group. In the eastern Cape Province, the stems are semi-prostrate to decumbent, about 10–20 cm long, with numerous glands and short, dense, adpressed pubescence on leaves and stems and scattered long, multicellular hairs on the stems. In the Transvaal, S.W. Africa and Rhodesia, the stems are more ascending, 30–45 cm high, and usually more conspicuously villous, though sometimes possessing only the glandular and adpressed pubescence. There is some indication that the plants may behave as annuals in South West Africa, though this requires investigation. Elsewhere the plants are perennial, often with somewhat tuberous roots in the young stage. The leaves are usually obovate to elliptic-ovate, faintly crenate at the rounded or obtuse apex and narrowly cuneate at the base. The inflorescence characters are relatively constant. In the bud stage, the inflorescence is a 4-angled spike 3–4 cm long, composed of 4 rows of densely imbricate, ovate, acuminate bracts.

The bracts are shed as each verticil of flowers starts to open. As flowering proceeds, the rhachis elongates, with the result that the verticils become separated by intervals of 5–15 mm, producing an interrupted spike of up to 15 cm long. Depending on the length of the inflorescence, 5–12 spaced verticils may be seen below the coma of bracts, the uppermost 3 or 4 still flowering and the lower ones in fruit, with the rhachis easily visible between the verticils. The corolla is usually about 1·5 cm long, varying from 1·2–1·8 cm. The lower lip is large and boat-shaped, purple to violet, while the upper lip is erect, small, whitish, mottled with bluish-purple.

Two closely related species, both of which bear epithets older than *C. neochilus*, must be taken into consideration, namely, *C. caninus* (Roth) Vatke (syn. *C. spicatus* Benth.) and *C. comosus* Hochst. ex Guerke. There seem to be adequate reasons at present for maintaining the three as distinct, though the tropical material seen is admittedly scanty. It is possible that when more good material becomes available from tropical territories the position should be reviewed again. In any case, the following notes will act as a guide to the characters to which collectors should give attention.

Both *C. caninus* and *C. comosus* can usually be separated from *C. neochilus* by their shorter, denser inflorescences. As the inflorescences start to flower they elongate slightly, but not to the extent of *C. neochilus*, so that the verticils do not become separate, except perhaps the lowest one or two. Even when flowering is well advanced, the spike is usually 3–5 cm long, rarely up to 9 cm long. The corolla in *C. caninus* is shorter than in *C. neochilus*, rarely exceeding 1 cm long, while in *C. comosus* it is usually longer than in *C. neochilus*, being 2–2·5 cm long. Usually in drying specimens the corolla becomes shrivelled or distorted, making measurements difficult.

C. caninus was described from India, and herbarium specimens were kindly sent on loan to us by the Forest Research Station, Dehra Dun, Pakhistan. Specimens matching the Indian material have been seen from Kenya, Tanganyika, Rhodesia and South West Africa. Seed was extracted from one specimen received from the latter territory (*Sachs* 2) and the resulting plants in cultivation behaved as annuals. It is also fairly definite that *Wild* 4544 from Rhodesia and *Greenway* 9190 from Tanganyika are annuals. Whether all material referrable to *C. caninus* is of annual habit is not known; if this proves to be the case, it would be an additional useful character for separating it from the predominantly perennial species, *C. comosus* and *C. neochilus*. Although no material has been seen of the type gathering of *C. omahekensis* Dinter, it seems clear from the somewhat scanty description that it is conspecific with the *Sachs* specimen, and so *C. omahekensis* is included in synonymy under *C. caninus*. The leaves of *C. caninus* are relatively long in relation to their width, being ovate-lanceolate to long-elliptic or oblanceolate, sparingly crenate-dentate in the upper half, acute to obtuse at the apex and long-cuneate at the base. As may be expected, there is considerable variation in stature and leaf size according to growing conditions.

C. comosus is essentially a plant of north-east Africa, chiefly Kenya and Abyssinia, and specimens have not been seen from territories south of Kenya. The possibility exists that it extends to Arabia. It is a perennial and, like *C. neochilus* and *C. caninus*, the leaves are aromatic and fleshy. In general the leaves are broadly obovate, faintly to distinctly crenate at the rounded apex and cuneate at the base. The flower spike is short, rarely becoming lax at the base and is borne usually on a long, slender, leafless rhachis.

The more important citations for *C. caninus* and *C. comosus* are set out for convenience below.

C. caninus (*Roth*) *Vatke* in Linnaea 37: 318 (1871), partly, excl. specimen cited; Guerke in Bot. Jahrb. 19: 212 (1895). Type: India, *Heyne* s.n.
Plectranthus caninus Roth, Nov. Pl. Sp. 279 (1821).

Coleus spicatus Benth. in Wall. Pl. As. Rar. 2: 15 (1831); Wall. Cat. 2729 (1831); Benth. in DC. Prodr. 12: 71 (1848); Wight, Ic. t. 1431 (1849). Type: India, *Wight* s.n. in Hb. Benth. *C. omahekensis* Dinter in Fedde Rep. Beih. 53: 123 (1928), ex descr. Syntypes: S.W. Africa, Grootfontein, Etemba, *Dinter* 3265; Otjikuara, *Dinter* 3265.

Found in India, east tropical Africa to Rhodesia and South West Africa.

S.W. Africa.—Grootfontein: Farm Kakuse, east of Etosha Pan, and plants cultivated in Pretoria from seed obtained from this gathering, *Sachs* 2.
S. Rhodesia.—Hartley: Poole Farm, *Wild* 4544.
Tanganyika.—Kilimanjaro, *Greenway* 6897.
Kenya.—Nairobi, *Verdcourt and Greenway* 399.

C. comosus *Hochst. ex Guerke* in Bot. Jahrb. 19: 212 (1894); Bak. in Fl. Trop. Afr. 5: 426 (1900); Bruce in Hook. Ic. Pl. 34: t.3374 (1938). *C. comosus* Hochst. in A. Rich., Tent. Fl. Abyss. 2: 183 (1851), in synonymy. *C. spicatus* [non Benth.], A. Rich., l.c. *C. caninus* [non (Roth) Vatke], Vatke in Linnaea 37: 318 (1872). Type: Abyssinia, *Schimper* 1328.

Specimens seen include the following: a plant cultivated in Pretoria, collected by Dr. P. J. Greenway near Nairobi; *Codd* 8238, a plant of unknown origin, cultivated in gardens in South Africa; *Gillett* 14080 and 14312 collected with the Kenya–Ethiopia Boundary Commission; and probably *Williams* 637 from Nairobi, though the flowers of this specimen appear smaller than usual.

The main characters which may be used in separating the three species are summarised below:—

C. neochilus. Plants perennial; leaves obovate to elliptic-ovate, faintly crenate at the rounded or obtuse apex; flower spike 7–15 cm long, lax below with 5–12 spaced verticils below the coma of bracts; corolla 1·2–1·8 cm long.

C. comosus. Plants perennial; leaves usually broadly obovate, faintly to distinctly crenate at the rounded apex; flower spike 3–5, rarely up to 9 cm long with one or two, rarely more, spaced verticils at the base; corolla 2–2·5 cm long.

C. caninus. Plants annual or, possibly, perennial; leaves ovate-lanceolate, long elliptic or oblanceolate, sparingly crenate-dentate in the upper half, apex acute to obtuse; flower spike 2–5, rarely up to 9 cm long, dense at the base; corolla 0·8–1 cm long.

South African Species of Satureia

by

D. J. B. Killick.

SATUREIA

Linn., Sp. Pl. ed. 1: 567 (1753), Gen. Pl. ed. 5: 247 (1754); Briquet in Engl. and Prantl. Nat. Pflanzenfam. 4, 3a: 296 (1896). *Micromeria* Benth. in Bot. Reg. 15: sub t. 1282 (1829).

The genus *Micromeria* was described by Bentham (1829), who distinguished it from *Satureia* on the grounds that the calyx was 13–15 instead of 10-nerved. Baker in Flora of Tropical Africa 5, 453 (1900) and Skan in Flora Capensis 5, 1: 306 (1912) in their treatments of Labiatae both upheld *Micromeria*. Briquet, however, reduced *Micromeria* to a synonym of *Satureia* explaining that the calyx nerves very often divide and that intermediate species made delimitation of the two genera impossible. Later taxonomists, for example Thonner, Flowering Plants of Africa, 479 (1915), Brenan in Mem. N. Y. Bot. Gard. 9, 1: 45–53 (1954) and now Hedberg, Afroalpine Vascular Plants, 160–164 and 317–318 (1957) have followed Briquet's classification. Until a critical revision of *Satureia* and related genera is undertaken, it seems desirable for the sake of uniformity in Africa, to follow recent workers and place our species under *Satureia*. The necessary name changes are made in this paper.

The generic name was originally spelled *Satureja* by Linnaeus, but the spelling *Satureia* is more correct philogically and is used here in accordance with Art. 74 (2) of the International Code of Botanical Nomenclature (1956).

Bracts foliose ..... 1. *S. grandibracteata.*
Bracts linear:
  Calyx tubular ..... 2. *S. biflora.*
  Calyx campanulate:
    Lower lip of corolla longer than upper ..... 3. *S. reptans.*
    Lower lip equal or shorter than upper ..... 4. *S. compacta.*

1. S. grandibracteata *Killick*, nom. nov.

Micromeria grandiflora Killick in Bothalia 6, 2: 439–440 (1954). Type: Cathedral Peak Forest Influences Research Station, *Killick* 1684 (PRE, holo.).

The epithet *grandiflora* cannot be used, because it is pre-occupied in *S. grandiflora* Scheele (1843).

For a description of *S. grandibracteata* see Killick (l.c.). No additional specimens of this species have been received since it was first described.

NATAL.—Bergville: Cathedral Peak Forest Influences Research Station *Codd and Dyer* 6241; *Killick* 1102, 1600, 1684.

2. S. biflora (*Buch. Hamilt.* ex *D. Don*) *Briq.* in Engl. and Prantl., Nat. Pflanzenfam. 4, 3a: 299 (1896). Type: Upper Nepal, Suemba, *Hamilton* s.n. (not located).

Thymus biflorus Buch. Hamilt. ex D. Don, Prodr. Fl. Nepal, 112 (1825). *Micromeria biflora* (Buch. Hamilt. ex D. Don) Benth., Lab. Gen. et Sp. 378 (1834).

A shrubby herb with numerous ascending branches, 20–60 cm high, pubescent, glandular-punctate; internodes 0·5–3 cm long. *Leaves* subsessile, narrowly elliptic to broadly ovate, 5–15 mm long, 1·5–10 mm wide, apex acute to obtuse, base broadly cuneate to round, entire. *Cymes* 1–9 flowered; peduncles 2–7 mm long, bibracteate; bracts linear, 1·5–2 mm long. *Calyx* tubular, 15-nerved; tube 2–3 mm long; teeth subequal, elongate-triangular, acuminate, somewhat spinous and reflexed. *Corolla* white or mauve; tube 5–6 mm long; upper lip emarginate, 1·5 mm long, 2 mm wide; lower lip 3-lobed, 4 mm long, 4–5 mm wide, lateral lobes rounded, middle lobe emarginate. *Stamens* didynamous, arcuate, upper 1 mm long, lower 2 mm long; anthers 2-celled, divaricate. *Disc* slightly lobed. *Style* included, 5 mm long; stigma bifid, lobes subequal. *Nutlets* oblong, 1 mm long, 0·5 mm wide.

Basutoland.—Quthing: Moyeni Mountain, Lelvaleng, *Dieterlen* 1346.

Cape.—Engcobo: Emgwali River, *Flanagan* 2809. Herschel: Sterkspruit, *Hepburn* 5. Umtata: Baziya, *Baur* 220; Nqadu woods, *Pegler* 1575.

Transvaal.—Barberton: Lomati, *Thorncroft* 2115. Heidelberg: *Mogg* 24170. Krugersdorp: *Mogg* 23161. Lydenburg: Kantoorbos, *Codd* 9787. Pietersburg: Duivelskloof, *Galpin* 10101, 11393. Pretoria: Leikenhoutskloof, *Mogg* 12433. Roodepoort: Roodepoort Ridge, *Mogg* 20254. Rustenburg: Farm Morgenzon, *Rose-Innes* 122. Soutpansberg: Louis Trichardt, *Letty* 247. District Unknown: Valdesia, *Schlechter* 4534.

S. biflora is an extremely variable species as regards leaf-shape, number of flowers and structure of calyx. It is here treated in its widest sense, following Baker (l.c. 452) who regarded the Tropical African species *S. punctata* (Benth.) Briq., *Micromeria ovata* Benth., *M. schimperi* Vatke and *M. purtschelleri* Gürke as synonyms. Subsequent workers have variously upheld these species. For example, Brenan (l.c. 45) considered *S. punctata* as distinct, likewise Hedberg (l.c. 161). Recently E. and K. Walther in Mitt. Thür. Bot. Gesell. 1, 4: 1–12 (1957) in a very detailed study of *S. biflora* and its allies upheld all the species sunk by Baker. According to these two workers typical *S. biflora* is restricted to the Himalayas and Eastern India and does not occur in Africa, but they allow for the presence in Africa of two of its varieties, namely var. *rhodesiaca* Walther and var. *villosa* Walther.

The problem was submitted to Mr. W. Marais our liaison officer at Kew who, together with Mr. P. Taylor of that institution, examined type material and specimens at Kew and the British Museum. Taking the whole range of material into consideration they decided that there was no justification whatever for upholding the species and varieties regarded by E. and K. Walther as distinct.

3. **S. reptans** *Killick*, nom. nov.

Micromeria pilosa Benth. in Hook. Icon. Plant. 15: t. 1522 (1886). Types: Faku's Territory, *Sutherland* s.n.; Natal, *Medley Wood* 3712 (both K).

Prostrate aromatic herb with slender branches up to 2 ft. 6 in. long, covered with numerous silvery multicellular hairs and a few unicellular gland-tipped hairs, glandular-punctate; internodes 1–5 cm long. *Leaves* ovate, 0·7–2·5 cm long, 0·6–2·0 cm wide, apex acute to rounded, base shallowly cordate to broadly cuneate, margins crenate with few teeth; petioles 1–5 mm long. *Flowers* 1–2 in axils of uppermost leaves (rarely 3, *Galpin* 11745). *Pedicels* threadlike, 0·7–3 cm long, bibracteate about the middle; bracts linear, 1–2 mm long. *Calyx* campanulate, 15-nerved; tube 2·5–4 mm long, teeth subequal, deltoid, 1–2 mm long. *Corolla* " white " (Galpin 11745 and 11925) to pale cobalt violet, often creamy yellow on lower side; tube 0·5–1·2 cm long, 3–7 mm wide at mouth, pilose and yellow inside on lower side; upper lip emarginate, 1–2 mm long, 3–6 mm wide; lower lip 3-lobed, middle lobe emarginate, 4–7 mm long, 3–7 mm wide, lateral lobes round, 2–3 mm diam. *Stamens* 4, didynamous, arcuate, lower 3 mm long, upper 1·5 mm long. *Disc* slightly lobed. *Style* 1 cm long, the posticous lobe the shorter. *Nutlets* oblong, 2 mm long, 1 mm wide.

NATAL.—Bergville: Cathedral Peak Forest Station, *Killick* 1272, 1429. Estcourt: Cathkin Peak, *Galpin* 11745; Bushmans River, *Medley Wood* 10894. Lions River: Lidgetton, *Mogg* 6890. Richmond: Byrne, *Galpin* 11925. Underberg: Bamboo Mountain, *McLean* 709.

A new name is necessary in *Satureia*, because of the existence of *S. pilosa* Velen. (1899) described from Bulgaria.

4. **S. compacta** *Killick*, sp. nov., *S. reptanti* Killick et *S. grandibracteatae* Killick affinis, ab ambabus habitu multo compactiore corollae labio antico quam posticum aequilongo vel breviore facile distinguitur.

Herba prostrata compacta multo ramosa glanduloso-punctata pilis multicelluraribus induta, internodiis 5–15 mm longis. *Folia* late ovata vel rotunda 0·5–1·1 cm longa, 0·4–1·0 cm lata, apice et basi rotunda, marginibus breviter crenatis, petiolis 2–4 mm longis. *Flores* in axillis foliorum solitarii. *Pedicelli* 3 mm longi infra medium bibracteati; bracteae lineari-lanceolatae 1·5 mm longae carinatae. *Calyx* campanulatus 15-nervis, tubo ad 2 mm longo, lobis aequalibus triangulari-lanceolatis c.2 mm longis. *Corolla* cobalto-violacea intus glabra; tubus anguste campanulatus 5 mm longus, labio antico 3-lobato lobis lateralibus rotundis 2 mm diam. lobo medio emarginato 2 mm longo 2–5 mm lato, labio postico emarginato 2 mm longo 3 mm lato. *Stamina* didynama, antica 3 mm longa, postica 2 mm longa, antheris 2-locularibus divaricatis. *Discus* leviter lobatus. *Stylus* inclusus 6 mm longus, stigmate bifido. *Nucellae* oblongae 1–8 mm longae 1–2 mm latae minute pubescentes.

NATAL.—Bergville: below the Amphletts, Cathkin Peak Area, *Killick* 1866 (PRE, holo.).

Prostrate, mat-forming, much-branched herb, covered with multicellular hairs (especially dense on stems), gland-dotted; internodes 0·5–1·5 cm long. *Leaves* broadly ovate to round, 0·5–1·1 cm long, 0·4–1·0 cm wide, round at base and apex, margins shallowly crenate; petioles 2–4 mm long. *Flowers* solitary in axils of leaves. Pedicels 3 mm long, bibracteate below middle; bracts linear-lanceolate, 1·5 cm long, keeled. *Calyx* campanulate, 15-nerved; tube just under 2 mm long; lobes equal, triangular-lanceolate, 2 mm long. *Corolla* cobalt-violet, glabrous inside except for few hairs at base of lower lip; tube narrowly campanulate, 5 mm long; lower lip 3-lobed, lateral lobes round, 2 mm diam., middle lobe emarginate 2 mm long, 2–5 mm wide; upper lip emarginate, 2 mm long, 3 mm wide. *Stamens* didynamous, somewhat arcuate, lower 3 mm long, upper 2 mm long; anthers 2-celled, cells divaricate. *Disc* slightly lobed. *Style* included, 6 mm long; stigma bifid, the posticous lobe the shorter. *Nutlets* oblong, 1·8 mm long, 1·2 mm wide, minutely pubescent.

This species was found growing at the side of a bridle path in *Festuca costata* Grassveld at 6,800 feet just below the Amphletts in the Cathkin Peak Area of the Natal Drakensberg. Although the author has spent nearly three years in the Drakensberg doing botanical survey work, he has seen *S. compacta* growing in only the one locality.

S. compacta is related to *S. reptans* and *S. grandibracteata*, but can be readily distinguished from these species. Vegetatively it differs in being denser and much more compact in habit; it forms mats about 45 cm in diameter. Florally it differs mainly in that the flowers are smaller and the lower lip of the corolla is equal or shorter than the upper lip.

x Ruttyruspolia, a Natural Intergeneric Hybrid in Acanthaceae

by

A. D. J. Meeuse and J. M. J. de Wet

A plant recently collected near Wyllie's Poort, Transvaal (*Meeuse* 9793) exhibited characteristics of both the genera *Ruttya* Harv. and *Ruspolia* Lindau and could not be matched by any herbarium specimens from tropical or South Africa. This, together with the fact that this plant, of which only one single specimen was seen, did not produce seeds, led to the assumption that it could be a hybrid between the only representatives of these genera occurring in the Soutpansberg area, viz., *Ruttya ovata* Harv. and *Ruspolia hypocrateriformis* (Vahl) Milne-Redh. var. *australis* Milne-Redh. As natural intergeneric hybrids are rare and had not before been reported in Acanthaceae, additional evidence was required to support the assumption.

Material and Methods

Flowers of the supposed *Ruspolia* parent were emasculated when the buds just began to show colour and pollinated two days later with *Ruttya* pollen. Root-tips for a study of the chromosome numbers were fixed in Randalph's (1935) " CRAF " fluid, dehydrated using n-butyl alcohol and embedded in a mixture of paraffin, beeswax and rubber. Sections were cut 12 μ thick and stained in Stockwell's (1934) solution. For a study of meiosis, anthers were fixed in 3:1 alcohol and propionic acid, squashed and stained in a propionic acid-carmine solution as described by Swaminathan, Magoon and Mehra (1954).

Results and Discussion

From the numerous pollinated flowers a few viable seeds were obtained. Two plants were raised which started flowering six months after planting. These plants are morphologically very similar to the clone *Meeuse* 9793 and differ from it only slightly in the colour of the corolla. This provides a strong indication of the hybrid origin of the plant discovered in Wyllie's Poort.

In the artificial hybrid the corolla has a peculiar mauvish-pink colour which is nearest " Rocellin Purple " (Ridgway, 1912, XXXVIII, 71" V. RR. *b*); in the wild plant the colour of the corolla is of a deeper hue. In the *Ruspolia* parent the corolla is a clear scarlet red (Bruce 1954) and in *Ruttya ovata* it is white with minute mauve-purple dots in the throat on the side of the lower lip.

The generic characters of the two parent genera involved are practically identical as regards genitalia, pollen morphology, fruit and seeds. The only essential difference between them is in the shape of the corolla which is more or less distinctly bilabiate with a short tube gradually widening into the throat in *Ruttya*, and sub-equally 5-lobed with a long narrow cylindric tube in *Ruspolia*. Cytologically they differ in basic chromosome number, but not in chromosome size. Both genera are characterised by extremely small chromosomes in multiples of $n = 9$ ($2n = 36$) in *Ruttya*, and $n = 7$ ($2n = 42$) in *Ruspolia*. During pollen development the chromosomes associate into 18 pairs in *Ruttya ovata* and into 21 pairs in *Ruspolia hypocrateriformis* var. *australis*.

The hybrids under discussion have most of the morphological characters of the *Ruspolia* parent, but a markedly shorter and somewhat wider corolla-tube. The inflorescence is elongated and pseudo-spicate and the corolla-limb subregularly 5-fid as in *Ruspolia*. The colour of the corolla in the hybrids is found in neither parent, but is characteristic of both the natural and the artificial hybrids. The corolla-lobes are marked on the inside (upper surface in open flowers) near the base with fine dots of a deep, somewhat purplish red to deep amaranth red, a character which is also derived from the *Ruspolia* parent.

The natural and artificially produced hybrids are completely sterile. Back-crossing with either of the parents proved unsuccessful. The natural hybrid has not been studied cytologically. The artificial one has 39 small somatic chromosomes. During pollen development pairing is almost completely absent between the two parental sets of chromosomes. In the pollen mother cells 39 univalents are usually present and these chromosomes are distributed at random over the two poles with an appreciable number of laggards which are excluded from the two daughter nuclei. Only very occasionally a maximum number of two bivalents was observed.

In our opinion this hybrid has excellent potentialities as an ornamental. Upon introduction into horticulture a convenient name is desirable, but as the hybrid is a sterile F_1 it is not deemed advisable to give it a scientific name at the specific level. Apart from the formal description of the hybrid genus, only a horticultural name is proposed. It is thought that the artificial hybrid and the natural one do not differ sufficiently to warrant different horticultural names for each of them.

× *Ruttyruspolia* A. Meeuse et de Wet, gen. hybr. nov. (*Ruttya* Harv. × *Ruspolia* Lindau), a *Ruttya* tubo corollae subcylindrato longiore, limbo subregulare 5-fido differt, a *Ruspolia* tubo corollae breviore recedit.

Ruttyruspolia 'Phyllis van Heerden' = *Ruttya ovata* Harv. ♂ × *Ruspolia hypocrateriformis* (Vahl) Milne-Redh. var. *australis* Milne-Redh. ♀.

In order to distinguish this hybrid from other theoretically possible *Ruttya* × *Ruspolia* hybrids, this name is intended only to include all F_1-hybrids (hybrid clones and subclones, respectively) which are derived from the parent species indicated above and resemble *Ruspolia hypocrateriformis* var. *australis* in morphological characters, except in the much shorter corolla tube. The colour of the corolla is a shade of "Rocellin Purple" (Ridgway XXXVIII, 71". V. RR. *b*), or approximately so. The corolla lobes are in addition marked near the base inside with fine dots of a deep red to amaranth red colour.

The horticultural name proposed commemorates the fact that it was Mrs. P. van Heerden of Louis Trichardt, Northern Transvaal, who first discovered the natural hybrid and subsequently introduced it into horticulture.

It is feasible that other intergeneric hybrids in Acanthaceae can be artificially produced, because although the basic chromosome number varies rather widely in this family, the same number (or a near number) is sometimes found in different genera (Grant, 1956, Raghavan, 1957, Takizawa, 1957, Mangenot and Mangenot, 1957). In this way horticultural novelties could be developed. Most Acanthaceae can easily be propagated by means of cuttings and the sterility in intergeneric crosses need, therefore, not be a hindrance. It may even be an asset because the flowers do not become fertilized and, as we have observed in × *Ruttyruspolia*, remain fresh for several days instead of wilting soon after having been pollinated (as is the rule in this family). Judging by our example, experimental cross-breeding work in this family for horticultural purposes seems promising and is to be strongly recommended.

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Notes and New Records of African Plants

by

Various Authors

ACANTHACEAE

Barleria (Sect. *Prionitis*) **ameliae** *A. Meeuse*, spec. nov., *B. delagoensi* Oberm. arcte affinis, sed bracteolis brevioribus, sepalis eglandulosis, sepalo postico sepalo antico excedens, praecipue differt.

Suffrutex erectus perennis pauce ramosus 30–60 cm altus. *Caules* subquadrangulati plus minusve puberuli vel sparsissime strigosi demum tereti, glabrescentes. *Folia* elliptica vel plus minusve ovato-elliptica vel subobovata firmiter herbacea in siccitate papyracea vel subpergamacea, breviter acuminata obtusa vel subacuta, pungentia, basi attenuata vel longe decurrentia, subglabra, 3–9 cm longa 2–5 cm lata, petiolis apice vel totus alatis ad 3 cm longis, spinis axillaribus paucis vel interdum nullis albescentibus 2–4 mm interdum ad 7 mm longis. *Flores* axillares subsessiles, in parte superiore ramorum in inflorescentias spiciformes aggregati, bracteolis lineari-subulatis pungentibus minutissime aculeato-hirtellis 4–6 mm longis. *Sepala* in apices pungentes attenuata extus sparse intus subdense strigosa, eglandulosa, sepalo antico 11–13 mm longo 5–6 mm lato, sepalo postico 14–17 mm longo 4–5 mm lato, sepalis interioribus angustioribus 11–13 mm longis 1·5–2 mm latis. *Corolla* flava, extus minute molliter pubescens, tubo 12–14 mm longo, labio superiore 18–20 mm longo 4-lobato lobis subaequalibus obovato-ellipticis c. 13 mm longis, labio inferiore integro 10–11 mm longo. *Pistillum* glabrum. *Capsula* 14 mm longa 4 mm lata attenuato-rostrata plus minusve puberula.

South West Africa.—Caprivi Zipfel: Eastern area, Mpilila Island, under trees on rock outcrop near Chobe River bank, *Killick and Leistner* 3391 (PRE, holo.!, K,L,M, SRGH, Windhoek, isos.!).

Southern Rhodesia.—Wankie: Wankie, *Levy* 150 (PRE), 1113 (PRE, SRGH); Wankie Game Reserve, vlei edge, *Wild* 4751 (PRE, SRGH). Nuanetsi: Lundi River, near rapids above big bend, in patches of woodland, *Davies* 2051 (SRGH).

Suffruticose erect perennial 30–60 cm high. *Stems* usually not much branched, when young green (drying brown) and quadrangular, somewhat puberulous and/or with very few strigose hairs, soon quite glabrous, ultimately terete and covered with a thin greyish-yellow to pale brown bark. *Leaves* elliptic or somewhat ovate or obovate-elliptic, firmly herbaceous drying papyraceous to somewhat pergamaceous, subentire, cuneate-attenuate to long-decurrent at the base, shortly acuminate into a blunt or subacute pungently mucronate apex, glabrous except a sparse strigose pubescence on the basal portions of midrib and main veins (mainly on lower surface) and along the subciliate margin, 3–9 cm long and 2–5 cm broad; cystoliths minute, inconspicuous; petioles winged by the decurrent leaf-base in upper part or throughout, up to 3 cm long, in the axils usually with straight to slightly curved whitish slender 2–4 mm, occasionally up to 7 mm long spines. *Flowers* subsessile in the axils of normal leaves and the uppermost ones in the axils of smaller floral leaves running into a terminal pseudo-spike; bracteoles linear-subulate, pungent, minutely scabrid-hirtellous, 4–6 mm long, pedicels very short, usually somewhat strigose. *Sepals* sparsely strigose outside, more densely so inside, subciliate, eglandular, attenuate into the pungent tips; of the outer oblong

lanceolate concave ones the anticous one is 11–13 mm long, 5–6 mm broad and usually with two adjacent small spines rarely a single spine at the apex, and the posticous one 14–17 mm long and 4–5 mm broad; inner sepals linear-lanceolate, 11–13 mm long and 1·5–2 mm broad. *Corolla* orange-yellow or creamy-yellow, on the outside finely and softly pubescent, more densely so on the 12–14 mm long tube; the upper lip 18–20 mm long, 4-lobed with subequal obovate-elliptic about 13 mm long lobes; the lower lip 10–11 mm long. *Pistil* glabrous. *Capsule* 14 mm long and 4 mm broad, greyish-brown, attenuate-beaked at the apex, somewhat puberulous.

This species is in habit exceedingly like *B. delagoensis* Oberm., a coastal species from Portuguese East Africa, but it differs constantly in the non-glandular sepals (with stipitate glands in *B. delagoensis*), of which the posticous one is the longest (it is the shortest in *B. delagoensis*), in the shorter bracteoles, in the usually shorter axillary spines; in the somewhat puberulous capsules (pilose in *B. delagoensis*) and in several other points. The leaves are more decurrent on the petiole and are relatively somewhat broader in *B. ameliae*, the cystoliths are inconspicuous (distinct in *B. delagoensis*), the sepals are shorter than in *B. delagoensis* (the three shorter ones up to 13 mm long, as against the longest three 17 mm long in *B. delagoensis*) and the relative lengths of the parts of the corolla are not the same: tube 12–14 mm long against 12 mm in *B. delagoensis*, the upper lip 18 mm long as against 21 mm; its lobes 13 mm against 15 mm and the lower lip 10–11 mm against 16 mm, i.e. a relatively longer tube and relatively (and absolutely) shorter limb in *B. ameliae* as compared with *B. delagoensis*. There are also differences in the degree and type of pubescence of stems, leaves and sepals. All these differences together indicate that in spite of the close resemblance the two forms are not of varietal status but represent two distinct species. This view is supported by the difference in ecology, *B. delagoensis* being a coastal plant found on alluvial soils near the sea-shore in an area with very mild winters, a high rainfall and a high humidity of the air almost throughout the year, whereas *B. ameliae* is a plant of the interior growing at altitudes between 1,000 and 3,000 ft. in areas with a lower annual rainfall and a pronounced dry winter season with low humidity and often low temperatures.

This species is named after Mrs. A. A. Mauve (née Obermeyer) who contributed so much to the knowledge of the genus *Barleria* in Southern Africa and kindly studied the cited material to confirm my views that the plant under discussion represents a hitherto undescribed taxon.

A. Meeuse

Barleria argillicola *Oberm.* sp. nov., *B. bolusii* Oberm. affinis, sed floribus solitariis planta subglabra bracteis absentibus corolla 3·5 cm longa differt.

Fruticulus parvus. *Rami e* rhizomate orti. *Folia* coriacea glabra nitida margine alba undulata integra vel parce spinosa. *Flores* solitarii. *Bracteae* absentes. *Corolla* 3·5 cm longa. *Stigma* capitata.

Small plants up to 20 cm high, deep rooted. *Stem* perennial, woody, rhizomatous giving off short annual shoots which are unbranched or form 1–2 short basal branches, minutely pubescent in the grooves, nodes bristly. *Leaves* lanceolate, ca 3 × 1 cm, coriaceous, glabrous, shiny, apex tipped with a short spine, tapered at the base into a short petiole, or sessile, margin white, wavy, entire or sparsely spinous. *Flowers* solitary, axillary, bractless. *Bracteoles* about as long as the leaves but narrower and with a prominent lateral nerve on each side of the midrib. *Calyx* with the posticous sepal broadly ovate, reticulate, spine tipped, about as long as the bracteoles; anticous similar to posticous but bispinous at the apex; lateral segments small, linear, 1 cm long. *Corolla* pale mauve, with a narrow tube 2 cm long, limb 5-lobed, regular, somewhat shorter than the tube. *Stamens* dissimilar, two protruding from tube, two smaller included, the fifth represented by a short filament only. *Ovary* glabrous, style filiform, stigma capitate. *Capsule* typical, 2 cm long.

NATAL.—Estcourt: Rensburg Spruit near Estcourt, eroded thornveld slopes, frequent in patches, in flower October 1944, *Acocks* 10701 (PRE, holo. NH iso); near Estcourt in Bushman's River Valley, eroded clay banks of Rensburg Spruit, with fruit, December 1943, *Acocks* 9968 (PRE, NH); *Edwards* 2458 (PRE).

The species comes under the section *Eubarleria*, *Pungentes*. The stigmas are confluent, capitate. Its nearest ally seems to be *B. bolusii* Oberm. (*B. mosdenensis* Oberm. is a synonym of *B. bolusii* Oberm.) but it is very different from this species. The flowers are solitary, the plant is glabrous except for a slight short pubescence on the stem and the corolla is 3·5 cm long. The narrow white leaf margin is a conspicuous character. Mr. D. Edwards who visited Acocks' locality in November 1959, found it there exclusively on the eroded, clayey neutral to alkaline soils. Excellent photographs and colour slides of the flowering plants were made by him.

Barleria saxatilis *Oberm.* sp. nov., *B. eleganti* S. Moore affinis, sed floribus minoribus dilute purpureis cymis parvifloris differt.

Suffruticosa. *Rami* strigosi et pilis brevibus patentibus dense pubescentes. *Folia* oblonga herbacea lamina inferiore pallide viridia. *Inflorescentiae cymae* unilaterales 1–4 florae; bracteoli lineares spinoso-dentati; sepalum posticum ovatum, spinoso-dentatum papyraceum reticulatum; sepalum anticum postico simile sed paulo minorius; corolla dilute purpurea, tubo angusto faucem versus gradatim paulo expanso 15 mm longo, limbo 5-lobato sub-regulari; stamina perfecta 2, exserta; stamina imperfecta brevia inclusa. *Capsula* glabra 1 cm longa 4 mm lata apiculata.

A straggling or erect shrub 30–150 cm tall. *Branches* woody white puberulous and strigose. *Innovations* densely strigose. *Leaves* variable in size, oblong to lanceolate, up to 3 cm long and up to 2 cm wide, usually smaller, apex obtuse, in 1–4 flowered sessile cymes. *Bracteoles* unequal, firm, spinoso-dentate, the lower smaller, linear, recurved from the base: the upper erect, lanceolate-acuminate. *Outer sepals* ovate, acuminate, up to 2 cm long including spine, 9 mm wide, with ca 16 marginal spines 1–3 mm long, reticulate, sparsely strigose, green at first, stramineous in fruit but apparently not enlarged. *Inner* sepals linear, 1 cm long. *Corolla* puberulous, bluish mauve; tube narrow, 15 mm long, slightly widened at the apex; limb 5-lobed ca 11 mm long. *Stamens* inserted in lower half of tube, the fertile ones well exserted, filaments linear; 3 sterile short, included, one represented by a minute filament only. *Ovary* glabrous, style filiform 2 cm long, with a ring of short hairs at the base; stigma short, filiform. *Capsule* glabrous, just exserted from the outer sepals, 1 cm long, 4 mm broad, apiculate.

Flowering. Period: March onwards.

Distribution: In the drier parts of the northern and eastern Transvaal, usually on rocky hillsides.

TRANSVAAL.—Soutpansberg: Sandrivier Poort, southern end, on a stretch 1–8 miles from main road bridge, *Meeuse* 10203 (PRE, holo.) Farm Soutpan, lower northern slopes of the Soutpansberge, *Obermeyer, Schweickerdt and Verdoorn* 130. About two miles south of Wyliespoort, *Meeuse* 9790. Pietersburg: *Rogers* 14151; Mokeetsi, *Obermeyer* TM 31977; two miles S.E. of Chuniespoort Hotel, *Obermeyer and Verdoorn* 13; Blaauwberg near Leipzig Mission Station, *Codd* 8713. Waterberg: Nylstroom Mountains north of Warmbad, *Obermeyer* TM 31978. Pilgrims Rest: Kruger National Park, Gorge, *van der Schijff* KNP 2294. Lydenburg: Rustplaats, *Taylor* 1943.

The species is closely related to *B. elegans* S. Moore but can be distinguished by its few flowered, mauve cymes, usually more dense pubescence and its thinner less rigid branches. The capsule of *B. elegans* usually reaches a length of 15 mm whilst that of *B. saxatilis* is only about 10 mm long. The calyx and bracteoles are also correspondingly smaller in *B. saxatilis*. It inhabits dry hot areas of the Transvaal

bushveld, where it has established itself very firmly, being dominant for miles in some parts. *B. elegans* occurs along the coast but is also found in more humid places in the Low Veld near rivers.

At Leipzig Mission Station Dr. Codd noticed that bunches of dried stems were tied round poles of grain stores to repel rats.

A. Amelia Obermeyer

Sclerochiton triacanthus *A. Meeuse*, spec. nov., *S. scissisepalo* C. B. Clarke affinis, sed inter alia ramulis pilosis, foliis minoribus angustioribus, bracteis fertilibus apice breviter trispinosis differt.

Frutex suberectus e basi ramosus 0·50–1·00 m altus. *Caules* subteretes lignosi breviter albo-pilosi, demum glabri, cinnamomei vel cinerascentes. *Folia* ad apicem ramulorum plus minusve aggregata, subcoriacea, subsessilia, nitida, oblongi-lanceolata vel lanceolato-linearia, integra, convexa vel subplana margine deflexa vel revoluta, basin versus interdum ciliata, apice pungentia, subglabra, 2–5 cm longa, 4–9 mm, interdum ad 15 mm, lata, costa media subtus prominenti interdum subtus basin versus sparse pilosa, cystolithis inconspicuis. *Inflorescentiae* terminales vel laterales, subsessiles pauciflorae densae, ad 6 cm longae, bracteis bracteolisque firmiter herbaceis plus minusve concavis carinatis vel subcarinatis puberulis vel subglabris plus minusve ciliatis. *Bracteae* oblongae vel lineari-oblongae, inferiorae steriles parvae innocuae vel pungentes, fertiles majores 14 mm longae 4 mm latae spinulis 3 apicalibus pungentes. *Pedicelli* satis robusti, 3–5 mm longi, bibracteolati, bracteolis lineari-lanceolatis sparse puberulis 16–18 mm longis 3–4 mm latis spinulis 1–3 pungentibus. *Sepala* 5, acuta, pungentia, subglabra, plus minusve ciliata; sepalum posticum late lineare acutum infra medium ciliatum, apice unispinulosum vel interdum 2–3-spinulosum, 23–24 mm longum, 4–5 mm latum, sepala 2 antica lineari-lanceolata, 16–18 mm longa, 3 mm lata, sepala lateralia lineari-lanceolata, 15–17 mm longa, 2–2·5 mm lata. *Corolla* dilute azurea, coeruleo-venosa, tubo ca 7 mm longo, limbo ca 19 mm longo extus parce sericeo intus lineis 2 pilorum subpatentorum cincto, lobis subaequalibus obovato-oblongis apice rotundatis 4–5 mm longis. *Stamina* basin versus retrorse sericea, filamentis ca 11 mm longis, antheris hirsuto-pubescentibus ca 2 mm longis. *Ovarium* puberulo-velutinum, apice pilis erectis comosum, 3–4 mm longum, stylo basin versus pilis setaceis patentibus albido-fulvidis barbato 14–15 mm longo. *Capsula* anguste oblonga, glabra, ca 14 mm longa.

Transvaal.—Barberton: Barberton, *Rogers* 24047 (PRE); about five miles from Barberton on road to Florence Mine, Mr. and Mrs. *P. F. Clarke* 12 (PRE, holo.!).

A somewhat straggly to erect low shrub, usually 40–60 cm tall but occasionally attaining about 1 m, branched from the base upwards, usually slender in habit, but in some cases forming a " bush " or thicket 1–2·5 m across. *Stems* subterete, woody, dark brown and shortly pilose with whitish patent hairs, usually rather densely so, later glabrescent and turning cinnamon-coloured or ashy-grey, forming a thin, nearly smooth or somewhat (longitudinally) wrinkled bark. *Leaves* more or less distinctly aggregated at the tips of the branches or on short side-shoots, subcoriaceous, subsessile, shiny, oblong-lanceolate to linear-lanceolate, entire, usually somewhat convex through the deflexed margins, glabrous or ciliate near the base, sometimes sparsely pilose on the midrib, narrowing at the base into the very short pilose petiole, subobtuse to acute at the spine-tipped apex, distinctly veined, 2–5 cm long and 4–9 mm (on young shoots occasionally up to 15 mm) broad; midrib prominent on lower surface; cystoliths indistinct or invisible. *Inflorescences* terminating the branches and short side-shoots, dense, few-flowered, up to about 6 cm long. *Bracts* oblong to linear-oblong, firm, green; lower sterile ones short, innocuous or pungent, fertile ones larger, about 14 mm long and 4 mm broad, more or less concave to boat-shaped and somewhat carinate, as are the bracteoles, puberulous or glabrous usually ciliate along the margins, especially about the middle, at the apex with three small spines. *Pedicels* rather stout, 3–5 mm

long, bibracteolate in the middle; bracteoles linear-lanceolate, with 1–3 small apical spines, sparsely puberulous, often somewhat ciliate, 16–18 mm long and 3–4 mm broad. *Sepals* 5, acute, pungent, subglabrous often somewhat ciliate; posticous sepal broadly linear, acute with 1–3 apical spines, 23–24 mm long and 4–5 mm broad; 2 anticous sepals linear-lanceolate, 16–18 mm long and 3 mm broad; 2 lateral sepals linear-lanceolate, 15–17 mm long and 2–2·5 mm broad. *Corolla* a light but bright blue with darker blue reticulate veins; tube about 7 mm long, glabrous; limb about 19 mm long, on the outside (lower side) silky pubescent, on the inside with two broad lines of hairs, its lobes subequal obovate-oblong rounded at the apex, 4–5 mm long. *Stamens* towards the base retrorsely silky pubescent; filaments about 11 mm long, anthers shortly hirsute-pubescent, 3–4 mm long. *Ovary* densely puberulous to velutinous and with a dense apical tuft of erect stiff, almost bristly hairs, 3–4 mm long; style 14–15 mm long towards the base with setaceous hairs which form an abaxial line becoming denser and broader towards the base, these hairs and those on the ovary yellowish and fawnish. *Capsule* narrowly oblong, glabrous, about 14 mm long.

This species was discovered by F. A. Rogers as early as 1921, but it was apparently not collected again till Mr. and Mrs. P. F. Clarke found it in the summer 1955/56. It is probably one of those local endemics in which the Barberton area is so rich. I am indebted to the collectors for the following extensive notes:

" The plant is a straggly, low-growing shrub, averaging about 2 ft. in height and possibly attaining a maximum of 3 ft. It is branched, usually slender, but in some cases forming a bush or thicket 3 or 4 ft. across. It is fairly common in the locality in which it was found, but we have not yet observed it elsewhere. It grows in shallow shaly soil, sloping steeply, on shale outcrops—a very well drained position, facing S.W. It occurs in fairly open bush consisting mainly of Kirkia, Bauhinia galpinii, Peltophorum, Bowkeria, Acacia ataxacantha, Heteropyxis, Ziziphus, Acacia karroo, Dalbergia, and in association with Royena, grasses, aloes, Orthosiphon, Crossandra and many other unidentified plants. The Schlerochiton is found in partial shade—where the bush is thick it does not occur. The flowers are clear blue in colour (see accompanying sketch). Unripe fruit are plentiful and a few ripe fruits were found."

Characteristic of the species are the narrow linear-oblong leaves with deflexed margins and the 3-spined fertile bracts, two characters which I have not found in any other species I have studied. The seeds in the capsules had all been eaten by insects and could not be described.

A. Meeuse

APOCYNACEAE

Acokanthera

When G. Don described the genus in his Gen. Syst. 4: 485 (1838), he explained that the name is derived from the Greek " acoce ", a mucrone, referring to the mucronate anthers characteristic of *Acokanthera* spp. In writing the Greek word he translated the Greek *kappa* in both cases as a roman *c*, but he spelt the generic name *Acokanthera*. Subsequent authors have considered that, to be consistent, the genus should be spelt either *Acocanthera*, as was done by Endlicher, Gen. Pl. Suppl. 1: 1404 (1841), Pfeifer, Nom. Bot. 1: 29 (1873) and K. Schumann in Pflanzenfam. 4. 2: 126 (1895), or *Akokanthera*, as proposed by Walpers, Rep. 3: 122 (1845). Stapf retained the spelling *Acokanthera* in Fl. Trop. Afr. 4, 1: 92 (1902) and in Fl. Cap. 4, 1: 499 (1907) but, in Kew Bull. 29 (1922), he stated a preference for *Acocanthera* " in the place of the absurd and barbarous form *Acokanthera*, found in G. Don's Generum Systema, which is evidently due to a printer's error ". There seems, however, equal reason for concluding that Don deliberately spelt the name *Acokanthera* and, unless there is clearer evidence to the contrary, this spelling should be retained.

Acokanthera is closely related to *Carissa*, under which genus it is placed in synonymy by Pichon in Mem. Mus. Nat. Hist. Paris, n.ser. 24: 132 (1948) and Bull. Jard. Bot. Brux. 22: 109 (1952). It is considered, however, that there are adequate reasons for maintaining it as distinct. In support of this view may be cited the essentially practical reason that species of *Acokanthera* have a characteristic facies, which permits the assignment of even sterile specimens without difficulty, even though the characteristics are not easy to define in words. Florally, the two genera are closely allied but, in *Acokanthera*, the inflorescence is axillary, not terminal or pseudo-axillary as in *Carissa*, and the stamens are situated at the apex of the corolla tube, with the tips of the anthers often exserted. In *Carissa*, the stamens are situated from about the middle of the tube to near the apex, with the mouth of the tube slightly constricted, so that the tips of the anthers are not visible. There are also small differences in the shape of anthers and stigma.

The genus *Carissa* (in the sense of Stapf in Flora Capensis and Flora of Tropical Africa) may be divided into two sections: Section *Carissa*, in which the corolla lobes overlap to the right; and Section *Arduina*, in which the corolla lobes overlap to the left (as in *Acokanthera*). Section *Carissa* includes armed and unarmed species, occurring in Africa, Madagascar, Asia and Australia. In Section *Arduina*, all species are armed (though occasional herbarium specimens may lack spines) and the species are limited to eastern and southern Africa. Thus, although the presence or absence of spines would not alone constitute a generic difference, the character may be used in conjunction with the direction of overlap of the corolla lobes to separate *Acokanthera* and *Carissa*. A further practical reason for keeping the two genera separate is that *Acokanthera* species all have a highly toxic substance in the sap, while this does not appear to be the case in species of *Carissa*.

Typification of the genus Acokanthera

As indicated by Phillips, Gen. S. Afr. Flow. Pl. ed. 2: 583 (1951), the type of the genus *Acokanthera* has been regarded as *A. venenata* G. Don, generally written *A. venenata* (Thunb.) G. Don. It is clear from what follows that this view can no longer be held without altering the circumscription of the genus. In order to retain the genus *Acokanthera* in its present sense, therefore, it is proposed that the type of the genus should be accepted as *A. lamarckii* G. Don, a superfluous name for *Cestrum oppositifolium* Lam., which is now combined in *Acokanthera*.

Acokanthera oppositifolia (*Lam.*) *L. E. Codd*, comb. nov.—*Cestrum oppositifolium* Lam. in Tab. Encycl. Bot. 2: 5, t. 112, fig. 2 (1797). Type: Africa, *Sonnerat* (P). *C. venenatum* Burm. f., Fl. Cap. Prodr. 5 (1768), non *Acokanthera venenata* G. Don (1838). Type: South Africa, *Banks* (G). *C. venenatum* Thunb., Prodr. 1: 36 (1794); Fl. Cap. ed. Schult. 193 (1823), non *C. venenatum* Burm. f. (1768). Type: South Africa, *Thunberg* (U).

Sideroxylon toxiferum Thunb., Trav. ed. 3, 1: 156 (1795), nom, nud.

Acokanthera lamarckii G. Don, Gen. Syst. 4:485 (1838), nom. illegit. Type: as for *Cestrum oppositifolium* Lam. *A. venatorium* E. Mey. in Drege, Zwei Pfl. Doc 171 (1843); Sond. in Linnaea 23: 79 (1850); nom. nud. *A. venenata* sensu Stapf in F.T.A. 4, 1: 94 (1902); F.C. 4, 1: 500 (1907); Sim, For. Fl. Cape Col. 270, t.154, fig. 1 (1907); Marloth, Fl. S. Afr. 3, 1: t.17 (1932); Brenan & Greenw., Check-list Tang. Terr. 2: 47 (1949). *A. venenata* (Burm. f.) G. Don ex C. A. Smith in J. S. Afr. For. Ass. 20: 42 (1951), nom. illegit. var. *scabra* (Sond.) Markgf. in Notizbl. Bot. Gart. Berl. 8: 470 (1949).

Toxicophlaea thunbergii Harv. in Hook. Lond. Journ. Bot. 1: 24 (1842); Thes. Cap. 10. t. 16 (1859); Sond. in Linnaea, 23: 78 (1850). Type: as for *Cestrum venenatum* Thunb. *T. thunbergii* var. *scabra* Sond., l.c. Type: based on several syntypes. *T. cestroides* A.DC. in DC., Prodr. 8: 336 (1844). Type: as for *Cestrum venenatum* Thunb.

Carissa acokanthera Pichon in Mem. Mus. Hist. Nat. Paris, n.s. 24: 132 (1948). *C. oppositifolium* (Lam.) Pichon in Bull. Jard. Bot. Brux. 22: 109 (1952).

In the protologue to *Acokanthera venenata*, G. Don cites *Cestrum venenatum* Thunb. and *C. citrifolium* Retz. It may be assumed that his intention was to take up Thunberg's epithet in his genus *Acokanthera*. As pointed out by Mr. Dandy on p. 428 of this journal, however, *C. venenatum* Thunb. (1794) must be regarded as an illegitimate homonym of *C. venenatum* Burm. f. (1768) and therefore has no standing. The epithet *venenatum* Burm. f. cannot be taken up in *Acokanthera*, thus the next legitimate name which is available, namely, *C. oppositifolium* Lam. must be adopted.

Nomenclaturally, because *C. venenatum* Thunb. is illegitimate, the name *Acokanthera venenata* G. Don becomes a synonym of *C. citrifolium* Retz. (for which it is a superfluous epithet), not of *C. venenatum* Thunb. *C. citrifolium* Retz. (1803) is based on a plant cultivated at Lund. The opportunity to study the type specimen was made possible by the kindness of the Keeper of the Lund Herbarium, Dr. Norlindh, who sent the holotype on loan to Pretoria. An examination of this specimen shows that it is not conspecific with *Cestrum venenatum* Thunb., as indicated by G. Don. It probably belongs to *Cestrum* or a closely allied genus and it is unlikely that it came originally from South Africa.

Acokanthera oblongifolia (*Hochst.*) *L. E. Codd*, comb. nov.—*Carissa oblongifolia* Hochst. in Flora, 827 (1844). Type: Natal, *Krauss* (K). *C. spectabilis* (Sond.) Pichon in Mém. Mus. Hist. Nat. Paris, n.s, 24: 132 (1948). *Toxicophlaea spectabilis* Sond. in Linnaea, 23: 79 (1850). Syntypes: Port Natal, *Gueinzius* 37; 511. *Acokanthera spectabilis* (Sond.) Hook. f. in Bot. Mag. t. 6359 (1878); Stapf in Fl. Cap. 4, 1: 501 (1907). *A. venenata* var. *spectabilis* (Sond.) Sim, For. Fl. Cape Col. 270, t. 154, fig. 2 (1907).

Mr. W. Marais examined type material of *Carissa oblongifolia* Hochst. (1844) at Kew and reports it to be conspecific with *Toxicophlaea spectabilis* Sond. (1850). The former epithet must, therefore, be taken up. *A. oblongifolia* is closely allied to *A. oppositifolia*, but can usually be distinguished by the longer corolla tube, the large, plum-like fruits and the indistinct secondary nerves on the underside of the leaves.

Acokanthera schimperi (*A.DC.*) *Schweinf.* var. **rotundata** *L. E. Codd*, var. nov., sed a typo foliis majoribus rotundioribus plerumque scabridis differt.

Frutex vel arbor parvus ad 3 m altus, ramulis tomentosis vel puberulis. *Folia* coriacea scabrida late elliptica usque subrotunda 4–7 cm longa 3·5–5·5 cm lata, apice obtusa usque rotunda mucronata, basi obtusa usque rotunda, nerviis secundariis obscuris, petiolo robusto 2–6 mm longo. *Inflorescentia* multiflora subsessilis corymbosa, bracteis ovatis 1·5 mm longis caducis, floribus sessilibus. *Calyx* 2–2·5 mm longus puberulus usque tomentulosus, sepalis ovato-lanceolatis acuminatis. *Corolla* hypocrateriformis, tubo subcylindrato 8–9 mm longo pubescenti vel glabro, lobis 5 ovatis obtusis 4.4·5 mm longis 2 mm latis. *Stamina* 5 in faucibus corollae inserta leviter exserta, antheris ovatis pubescentibus breviter mucronatis. *Ovarium* integre 2-loculare, loculis 1-ovulatis, stylo filiforme 7–8 mm longo, stigmate parvo conico apice bifido. *Fructus* baccatus globosus vel subglobosus 1·5–2 cm diam. *Semina* 1–2 late elliptica, endospermo carnoso.

Transvaal.—Sibasa: Kruger National Park, 3½ miles N. of Klopperfontein, alt. 1,400 ft., flowering and fruiting March 1949, *Codd* 5432 (type, PRE). Pietersburg: Chuniespoort, *Pole Evans* H 19451. Nelspruit: Kruger National Park, Klokwene, *van der Schijff* 758.

S. Rhodesia.—Mangwe, *Plowes* 1308. Matoppo Hills, near Bulawayo, *Galpin* 7076; *Eyles* 6303; *Miller* 5162.

Shrub or small tree up to 3 m high; branchlets tomentose or puberulous. Leaves coriaceous, scabrid, broadly elliptic to subrotund, 4–7 cm long and 3·5–5·5 cm broad, apex obtuse to rounded, mucronate, base obtuse to rounded; secondary nerves obscure; petiole stout, 2–6 mm long. *Inflorescence* many-flowered subsessile, corymbose; bracts ovate, 1·5 mm long, caducous; flowers sessile. *Calyx* 2–2·5 mm long, puberulous to tomentulose; sepals ovate-lanceolate, acuminate. *Corolla* hypocrateriform, tube subcylindric 8–9 mm long; pubescent or glabrous; lobes 5, ovate, obtuse, 4–4·5 mm long and 2 mm broad. *Stamens* 5, situated in the corolla throat, slightly exserted; anthers ovate, pubescent, shortly mucronate. *Ovary* entire with 2 locules, 1 ovule in each locule; style filiform 7–8 mm long; stigma small conical, apex bifid. *Fruit* baccate, globose or subglobose, 1·5–2 cm in diameter. *Seeds* 1 or 2, broadly ellpitic; endosperm fleshy.

The species of *Acokanthera* fall into three main groups, namely: (*a*) *A. schimperi*, *A. deflersii*, *A. ouabaio* and *A. friesiorum;* (*b*) *A. oppositifolia*, *A. longiflora* and *A. rhodesica;* and (*c*) *A. oblongifolia.*

The plant now described, with its subrotund leaves, indistinct secondary venation and more or less globose fruits clearly belongs to group (*a*). The material that has been seen of this group leads to the impression that there may be only one variable species involved. The oldest name is *A. schimperi* (A.DC.) Schweinf. and the other three may well be reduced to synonymy, or to varieties, as Stapf has already done with *A. deflersii.*

In its usually scabrid leaves, var. *rotundata* resembles *A. deflersii* from Arabia, while in leaf shape it is closer to *A. friesiorum*, though it differs in having larger and less glossy leaves. In distribution it is completely separated from the *A. schimperi* complex, which is recorded from Kenya to southern Arabia, but its characteristics are not sufficiently clear-cut to warrant separating it as a distinct species.

Carissa

Carissa bispinosa (*L.*) *Desf. ex Brenan* in Mem. N.Y. Bot. Gard. 8: 502 (1954), aggregate species.

The *C. bispinosa* complex is distrubuted from the south-western Cape Province to Natal, Swaziland, Transvaal and Mocambique, extending northwards to Nyasaland and westwards to Bechuanaland and South West Africa. There is considerable variation in leaf size, shape and texture, size of spines, and situation of the anthers in the corolla tube.

Two main evolutionary trends are recognised and two varieties are upheld. The two varieties overlap geographically, especially in the southern and eastern Cape Province; here several intermediate specimens are found and it is for this reason that the two groups were regarded as not having the status of separate species.

(*a*) var. **bispinosa.**

Arduina bispinosa L., Mant. 1: 52 (1767). Type: the plate in Mill. Ic. 2: t. 300 (1760). *Lycium cordatum* Mill., Gard. Dict. ed. 8: No. 10 (1768). *Carissa bispinosa* (L.) Desf. ex Brenan, l.c., excl. specimen cited. *C. bispinosa* Desf., Tabl. Ecol. Bot. 78 (1804), nom. nud.; Desf. ex Steud., Nom. ed. 2: 298 (1841), in synonymy; Merxm. in Mitt. Bot. Munchen, 17–18: 399 (1957). *C. arduina* Lam., Dict. 1: 555 (1785); Stapf in Fl. Cap. 4, 1: 498 (1907), partly, excl. syn. *C. erythrocarpa*, *C. acuminata*, *C. haematocarpa*, *C. ferox*, and *C. oblongifolia*. *C. myrtoides* Desf., Cat. Hort. Paris, ed. 3: 398 (1829). *C. cordata* (Mill.) Fourc. in Trans. Roy. Soc. S. Afr. 21: 82 (1934). *C. cordata* Dinter in Fedde Rep. Beih. 53: 112 (1928), nom. nud. *C. dinteri* Markgf. in Notizbl. Bot. Gart. Berlin, 15: 750 (1942). *Jasminonerium bispinosum* (L.) O. Ktze., Rev. Gen. Pl. 2: 415 (1891).

A much-branched, twiggy shrub up to 3 m high. Leaves thickly coriaceous, 1–3 (rarely to 5) cm long, broadly ovate to ovate-elliptic. Spines robust, up to 5 cm long, bifurcate, twice bifurcate or simple. Anthers situated near the apex of the corolla tube. Style 3–4 mm long.

This variety is found in karroid scrub, bushveld and coastal scrub vegetation, usually in relatively hot, dry situations, in the southern and south-eastern Cape Province, central and western Transvaal and northern South West Africa.

In some specimens from the eastern Cape Province, the robust spines are twice bifurcate, while from the central and western Transvaal and South West Africa specimens are found with simple spines. *C. dinteri* Markgraf is based mainly on the presence of simple spines; in all other respects it is scarcely distinguishable from var. *bispinosa* and is therefore not worth upholding, even as a variety.

The significance of the position of the anthers and length of the style is discussed later under var. *acuminata*.

(*b*) var. **acuminata** (*E. Mey.*) *L. E. Codd*, stat. nov.
Arduina acuminata E. Mey., Comm. Pl. 191 (1837); K. Schum. in Pflanzenfam. 4, 2: 126 (1895). Type: between Umzimvubu and Umsikaba Rivers, near large Waterfall, *Drege*. *A. erythrocarpa* Eckl. in S.A. Quart. J. 4: 372 (1830). *Carissa acuminata* (E. Mey.) A.DC. in DC. Prodr. 8: 335 (1844). *C. erythrocarpa* (Eckl.) A.DC., l.c. *C. arduina* (non Lam.), Stapf in Fl. Cap. 4, 1: 498 (1907), partly, as to syn. *C. acuminata* and *C. erythrocarpa*. *C. megaphylla* Gdgr. in Bull. Soc. Bot. France, 65: 59 (1918). *C. bispinosa* [non (L.) Desf. ex Brenan], Brenan in Mem. N.Y. Bot. Gard. 8: 502 (1954), as to specimen cited.

Shrub up to 5 m high, often sparingly branched and sometimes semi-scandent. Leaves thinly coriaceous to coriaceous, ovate to ovate-lanceolate, 2·5–7 cm long. Spines slender, bifurcate, 0·5–2·5 (rarely to 3·5) cm long. Anthers situated near the middle or towards the apex of the corolla tube. Style 1·5–3 (rarely to 3·5) mm long.

This variety is found in fairly dense woodland such as forest margins and scrub forest in the southern and south-eastern Cape Province, Natal, Swaziland, eastern and northern Transvaal, eastern Southern Rhodesia and Nyasaland.

The anthers are situated near the middle of the corolla tube or towards the apex and, as the stigma accompanies the anthers, the style is shorter in this variety than in var. *bispinosa*. The distinction is more marked from the Transvaal northwards, rather than in the Cape Province and Natal, as is shown in Table I and II which summarise the distribution of style length on a geographical basis in 69 specimens examined.

TABLE I

Style length in 28 specimens of *C. bispinosa* var. *bispinosa*.

Province.	Style length in mm.							Total.
	1·5	2	2·5	3	3·5	4	4·5	
Cape	—	—	—	5	2	1	—	8
S.W. Africa	—	—	—	—	—	1	—	1
Transvaal	—	—	1	2	8	6	1	18
Mocambique	—	—	—	—	1	—	—	1
	—	—	1	7	11	8	1	28

TABLE II

Style length in 41 specimens of *C. bispinosa* var. *acuminata*.

Province.	Style length in mm.							Total.
	1·5	2	2·5	3	3·5	4	4·5	
Cape	—	2	7	5	1	—	—	15
O.F.S.	—	—	—	1	—	—	—	1
Natal	—	2	4	4	—	—	—	10
Swaziland	—	—	1	—	—	—	—	1
Transvaal	7	4	—	1	—	—	—	12
S. Rhodesia	1	—	—	—	—	—	—	1
Nyasaland	1	—	—	—	—	—	—	1
	9	8	12	11	1	—	—	41

An unusual form occurs at high altitudes in the central Transvaal and is represented by the following specimens: Lydenburg District, summit of Lulu Mountains, 4,500 ft., *Mogg* 16963; *Barnard* and *Mogg* 995; Pietersburg District, Wolkberg, 6,000 ft., *Gerstner* 5657. In these specimens the branches are extremely twiggy with very numerous, relatively short, stout, bifurcate spines; the leaves are small, broadly ovate, almost cordate-based, 1–1·5 cm long; and the flowers are smaller than usual with styles 1·5–2 mm long. These specimens have been omitted from the above Tables. They may represent a distinct variety but, until more information is forthcoming, they are best regarded as a form of *C. bispinosa* var. *bispinosa*.

ADENIUM

Adenium obesum (*Forsk.*) *R. and S.* var. **multiflorum** (*Klotzsch*) *L. E. Codd*, stat. nov.—*A. multiflorum* Klotzsch in Peters, Reise Mossamb. Bot. 279, t. 44 (1861). Type: Tette, *Peters* s.n.

I am indebted to Mr. W. Marais, our liaison officer at Kew, and Mr. Meikle, of the Kew staff, for examining the tropical African material of *Adenium* for me. They came to the conclusion that an excessive number of species names have been published and that the following must be regarded as one species complex: *A. obesum* (Forsk.) R. and S., Syst. Veg. 4: 411 (1819), based on *Nerium obesum* Forsk., Fl. Aegypt.–Arab. 205 (1775); *A. honghel* A.DC. in DC., Prodr. 8: 412 (1844); *A. multiflorum* Klotzsch, l.c.: *A. speciosum* Fenzl in Sitzungsber. Kais. Akad. Wiss. Wien, 51: 140 (1865); *A. arabicum* Balf. f. in Trans. Roy. Soc. Edinb. 31: 161 (1888); *A. micranthum* Stapf in Kew Bull. 334 (1894); and *A. coetanum* Stapf in Fl. Trop. Afr. 4, 1: 227 (1902). Of these, it is considered that only *A. multiflorum* is sufficiently distinct to be worth separating as a variety. It is fairly constant in having acute to acuminate corolla lobes with crisped margins, while the margins are a darker pink, almost scarlet in colour. The southern material has thicker leaves with more or less immersed veins, as against the thinner, markedly veined leaves of material from east and west tropical Africa.

TYPIFICATION OF *PACHYPODIUM SUCCULENTUM* AND *P. BISPINOSUM*

When Linn. fil. described *Echites succulenta* and *E. bispinosa* in his Suppl. 167 (1781), he mixed the characters of the two species. For instance, he describes *E. succulenta* as: "foliis linearibus subtus tomentosis, corollis infundibuliformibus" and *E. bispinosa* as: "foliis lanceolatis glabris, corollis hypocrateriformibus". Actually, the species with leaves tomentose below has the hypocrateriform corolla and *vice versa*.

Both species were based on *Thunberg* specimens " ad Cap. bonae Spei ", and were transferred to the genus *Pachypodium* by A. de Candolle in DC. Prodr. 8: 424 (1844).

Thunberg in his Prodromus, 37 (1794) and Fl. Cap. ed. Schult. 232 (1823) repeats the protologue verbatim but, in the latter work, he adds a more detailed description of the corolla of *E. bispinosa* which agrees with an infundibuliform, not a hypocrateriform, corolla.

E. Meyer, Comm. Pl. 188 (1837) created the genus *Belonites* to accommodate the above two species. He evidently realised the original discrepancy and placed the characters correctly, typifying the species as follows:

1. *Belonites succulenta:* " foliis subtus tomentosis, corollis hypocrateriformibus, limbi laciniis spathulatis. *Echites succulenta* Thunb."

2. *B. bispinosa:* " foliis subtus glabris, corollis infundibuliformibus, limbi laciniis basi latissimus. *Echites bispinosa* Thunb."

This emendation by E. Meyer was followed by Stapf in Flora Capensis 4, 1:517 (1907) and subsequent workers. It is, however, necessary to assess the available *Thunberg* specimens to discover if any specimens bear clear evidence that they were studied by Linn. fil. There are no relevant specimens in the Linnaean Herbarium, so the Directors of the Herbaria at Uppsala and Stockholm were approached. Uppsala Herbarium does not send Thunberg specimens on loan, but the Director informs me that there are three relevant sheets in the Thunberg Herbarium. One of these is named *Echites succulenta*. It has linear leaves, tomentose on the underside and the corolla is badly pressed but is probably hypocrateriform. This specimen bears a determination by N. E. Brown: " *Pachypodium succulentum* A.DC." The other two sheets are named *Echites bispinosa* and are designated α and β. The determination of the first one was confirmed by N. E. Brown. It consists of a specimen with lanceolate leaves which are sparingly hispid on the underside, while the flowers appear to be infundibuliform. On the second sheet, N. E. Brown has placed a note reading: " The specimen marked X is the only one of *E. bispinosa* on this sheet, all the others belong to *E. succulenta* and have probably been mounted here by mistake ". None of the specimens bear any indication of having been studied by the younger Linnaeus.

The Director of the Stockholm Herbarium kindly sent us their specimens on loan. Five sheets were received, four of which consisted of solitary specimens collected by Thunberg, while the fifth was a mixed sheet with one Thunberg specimen and two Sparrman specimens. None of them show any annotation by Linn. fil. and therefore for purposes of selecting lectotypes they would have the same standing as the Uppsala specimens. As I have seen the Stockholm specimens, the following lectotypes are proposed:

Pachypodium succulentum (Linn. f.) A.DC. Lectotype: The sheet in Stockholm leg. *Thunberg*, Cap. b. Spei, on which is written at the back of the sheet: " Echites (succulenta) aculeis binis extrafoliaceis, foliis linearibus subtus tomentosis, corollis infundibuliformibus ". The corolla of the specimen is, in fact, hypocrateriform, and matches what we have been accusomed to calling *Pacypodium succulentum*.

Pachypodium bispinosum (Linn. f.) A.DC. Lectotype: The sheet in Stockholm leg. *Thunberg*, Cap. b. Spei, on which is written at the back of the sheet: " Echites (bispinosa) aculeis binis extrafoliaceis, foliis lanceolatis glabris, corollis hypocrateriformibus ". The corolla is, in this case, clearly infundibuliform and the specimen matches what we have been accustomed to calling *Pachypodium bispinosum*.

The other two Stockholm sheets consist each of a somewhat scrappy *Thunberg* specimen annotated *Echites bispinosa*, both of which are what we are calling *Pachypodium succulentum*. The sheets in Stockholm thus agree in essentials with those at Uppsala, i.e., two specimens (one of each species) are named in accordance with modern usage, while two are wrongly named. If the first two are selected as lectotypes, the

application of epithets will continue as at present, which agrees with the emendation made by E. Meyer. It is probable that the confusion in the published description by Linn. fil. resulted from an error in transcription and is not due to flowers of one species having been mounted in juxtaposition with a vegetative portion of the other species.

Strophanthus

Strophanthus luteolus *L. E. Codd*, sp. nov., *S. petersiano* Klotzsch affinis, sed floribus parvioribus, calyce angustiori, ramulis calyce corolla pubescentibus differt.

Frutex sarmentosus 3–8 m altus, ramulis junioribus pubescentibus sparse lenticellatis. *Folia* brevissime petiolata ovato-elliptica vel oblongo-elliptica 2·5–4·5 cm longa 1–1·5 cm lata, apice acuta vel rotundata, sparse pubescentia deinde glabrescentia. *Cymae* in ramis abbreviatis terminales, tomentosae, 1–3-florae; bracteae lineares 9–10 mm longae. *Calyx* tomentosus; sepala lanceolato-linearia 1–1·3 cm longa. *Corolla* luteola extus purpureo-striata dense puberula; tubi pars infra stamina cylindrata 6 mm longa, supra stamina infundibuliformis 7 mm longa 7–9 mm lata; lobi basi ovato-lanceolati in caudas lineares attenuati 5–8 cm longi; faucium squamae lanceolatae 2·5 mm longae. *Antherae* lanceolatae sagittatae acuminatae 3·5–4 mm longae. *Ovarium* dense pubescente. *Folliculi* anguste fusiformes fusco-brunnei lenticellati 22 cm longi 1·5 cm diam.

Transvaal.—Soutpansberg: Wylliespoort, flowering September, 1960, *Hardy and Wells* 359 (PRE, holotype); near the Salt Pan, fruiting September, 1960, *Hardy* 350.

Natal.—Ingwavuma: Maputaland, flowering June, 1914, *Maputa Expedition* in TM 14460; Mkuzi–Maputa areas, flowering December 1945, *Bell Marley* in NH 40920; Ndumu Game Reserve, flowering October 1959, *Tinley* 499.

Scandent shrub or climber 3–8 m high; branchlets shortly crisped-tomentose, glabrescent with age; bark reddish-brown, lenticellate. *Leaves* shortly petioled, drying dark green or brownish above, paler below, subglabrous or sparingly pubescent with scattered hairs along the midrib and margin, eventually glabrescent, ovate-elliptic to elliptic-oblong, 2·5–4·5 cm long and 1–1·5 cm broad, base obtuse to acute, apex acute to rounded, occasionally emarginate; margin incurved; secondary nerves 4–6 on each side, distinct; petiole 2–4 mm long; axillary glands small, tooth-like. *Inflorescence* terminal, usually on short lateral shoots, 1–3-flowered, pubescent; bracts linear, acute, 9–10 mm long, pubescent; pedicels 7–10 mm long, crisped-tomentose. *Flowers* yellowish with purple markings in the throat and on the outside of the tube. *Calyx* 1–1·3 cm long; sepals linear-lanceolate, tapering gradually to the apex, shortly pubescent. *Corolla* shortly and densely pubescent without and within; tube subcylindric for 6 mm then widening gradually to a funnel-shaped portion 7 mm long and 7–9 mm broad at the mouth; lobes lanceolate at the base, attenuate into linear-filiform appendages, pendulous, 5–8 cm long, shortly pubescent on both surfaces; throat scales lanceolate, 2·5 mm long. *Stamens* included; filaments thick, 1 mm long, pubescent; anthers connivent, lanceolate, 3·5–4 mm long, acuminate, shortly apiculate, sagittate, polliniferous in the upper half, hairy on the back. *Ovary* of two free carpels, densely pubescent; style 7–8 mm long; stigma enclosed by the anthers, capitate, with a reflexed frill at the base. *Follicles* narrowly spindle-shaped, reddish-brown, about 22 cm long and 1·5 cm in diam., lenticellate, tapering gradually then abruptly thickened at the apex.

Although superficially resembling *S. gerrardii* Stapf and *S. petersianus* Klotzsch, *S. luteolus* differs from both these species in the pubescent twigs and flower parts. From *S. gerrardii* it differs, in addition, in the longer calyx and erect, not recurved, sepals, while from *S. petersianus* it differs in the smaller, differently coloured corolla and the narrower sepals, as well as in leaf size and shape. It does not run to any species in Gilg's monograph on *Strophanthus* (Engler, Monogr. Afr. Pfl. Fam. vii, Stroph.,

1903), nor in Stapf's treatment in Flora of Tropical Africa. Among more recently described species, it appears to come nearest to *S. hirsutus* H. Hess in Ber. Schweiz. Bot. Ges. 62: 88 (1952), based on specimens collected in Angola, but differs in several important characters, for example, the longer calyx, the more funnel-shaped corolla tube and the pubescence of the leaves, which is never densely tomentose on both surfaces as in *S. hirsutus*. A duplicate of *Tinley* 499 was sent to Mr. Marais at Kew who reports that it is not matched in the Herbarium of the Royal Botanic Gardens.

The species is known from three gatherings in Maputaland, the north-eastern extremity of Zululand, and from recent gatherings in the Soutpansberg. In Maputaland it is found in coastal forest, climbing into the canopy, while in the Soutpansberg it grows on relatively dry, wooded hillsides, producing numerous slender stems which climb when they find the support of shrubs or trees. The older stems do not produce corky, winged out-growths, as is the case with *S. gerrardii*. The flowers are creamy-yellow, with a purplish tinge in the throat and on the outside of the corolla tube.

L. E. Codd

ARACEAE

Zantedeschia jucunda *C. Letty*, sp. nov., *Z. pentlandii* (Whyte ex Watson) Wittm. affinis, sed ita differt: folia trianguli-hastata dense maculata sub-conduplicata, spatha saturatior lutea interdum intus rugosa subregulariter infundibuliformis ad fauces valde aperta apice in acumen subulatum attenuata.

Planta decidua habitu rigido. *Folia* glabra, petiolis 24 cm longis glabris, laminis saturate viridibus maculatis 17–30 cm longis 5–15 cm latis trianguli-hastatis acutis apice subulatis subconduplicatis, lobis basalibus obtusis interdum acutis sursum patentibus ad 14 cm longis basi 7 cm latis. *Pedunculus* foliis aequalis vel longior glabrus viridis. *Spatha* 10–16 cm longa, intus saturate lutea leviter rugosa macula purpurea, extus saturate lutea, limbo subhorizontaliter patenti in acumen subulatum ad 1·5 cm longum attenuato. *Spadix* ad dimidium longitudinis spathae attingens cylindratus obtusus. *Ovaria* c.24 subglobosa angulata sessilia, stigmate 0·5 mm longo sessili discoideo, staminodiis nullis. *Antherae* luteae.

Transvaal.—Lydenburg: Lulu mountains, Sekukuniland, *Barnard and Mogg* 991 (PRE, holotype); Schoonoord, west slope of Lulu mountains, *du Plessis* in PRE 28835; *Barnard* 180; summit of Lulu mountains *Barnard* 181; Magnet Heights, *Thompson* in PRE 28836 (cult).

Description.—Plant deciduous, up to 60 cm high, glabrous, fairly rigid in habit. *Leaves* with petiole 24 cm long; blade dark green, densely maculate with elongate-white translucent spots, 17–30 cm long, 5–15 cm broad, triangular-hastate, acute with a subulate tip, semi-folded along the midrib; basal lobes obtuse or sometimes acute, upwardly spreading, up to 14 cm long, 7 cm broad at the base often smaller and narrower. *Peduncle* as long as, or longer than, the leaves, glabrous, green. *Spathe* 10–16 cm long, deep yellow with a purple blotch, slightly rugose within, deep yellow without; limb sub-horizontally spreading, tapering to a subulate green tip up to 1·5 cm long. *Spadix* up to half as long as the spathe, sometimes longer, cylindric obtuse. *Ovaries* sub-globose angled from pressure, sessile about 24 in number; stigma 0·5 mm long, sessile, discoid; staminodes none. *Anthers* yellow.

Specimens of this most striking *Zantedeschia* from Sekukuniland have been sent, from time to time, to the National Herbarium, Pretoria, since 1934. The first arrived in November 1934 from Mr. W. G. Barnard (No. 180) and further material was received in January 1939, collected by Barnard and Mogg (No. 991). In 1954 living material was sent in by Miss S. Thompson of Haenertsburg, grown from plants collected at Magnet Heights. The Native Commissioner, Schoonoord, kindly supplied plants in

February 1955 which flowered in Pretoria in January 1956 and in December of the following year further material from Schoonoord was received from Mr. S. S. du Plessis.

The species has been named *Z. jucunda* because of the pleasing appearance of the plants with deep green copiously spotted leaves and the almost campanulate spathe being brilliant deep yellow both without and within. Its distribution seems restricted to the Schoonoord–Magnet Heights region of the Lulu mountains, Sekukuniland, where it flowers from November to January.

It is most nearly related to *Z. pentlandii* (Whyte ex Watson) Wittm. and *Z. tropicalis* (N.E. Br.) C. Letty. It differs from the former in having triangular-hastate copiously spotted leaves with upwardly spreading basal lobes and an acute tip, the spathe a deeper yellow without and within and sometimes rugose within, and in the limb more spreading and tapering to a subulate tip, whereas *Z. pentlandii* has immaculate (very rarely spotted) oblong lanceolate leaves, slightly constricted above the short sagittate rounded basal lobes, apex obtuse, sometimes acute, with subulate tip, the spathe regularly funnel-shaped, limb lighter in colour, greenish outside, more suddenly rounded into the subulate tip. *Z. jucunda* can be distinguished from *Z. tropicalis* in its less luxuriant growth, stiffer, more inwardly folded triangular leaves, but chiefly in the less tightly rolled, consistently more brilliantly yellow more tapering spathes, whereas *Z. tropicalis* shows white, cream or salmon pink colour variations, but is never deep yellow.

Zantedeschia tropicalis (*N.E. Br.*) *C. Letty*, stat. nov., *Richardia melanoleuca* Hook. f. var. *tropicalis* N.E. Br. in Fl. Trop. Afr. 8: 168 (1901). *Zantedeschia melanoleuca* Hook. f. var. *tropicalis* (N.E. Br.) Traub in Plant Life 4: 24 (1948). Lectotype: Nyasaland: Namasi, *Cameron* s.n. (K) (2 sheets).

On studying a series of plants of *Zantedeschia melanoleuca* var. *tropicalis* both in the veld and preserved, the differences between these plants and typical *Z. melanoleuca* seemed important enough to warrant raising the variety to specific rank. Whereas *Z. melanoleuca* seems to be restricted to the coastal regions of Natal, *Z. tropicalis* occurs from Nyasaland through Southern Rhodesia into the Transvaal to Potgietersrus, Letaba and Barberton and to the Mbabane district of Swaziland.

It differs from *Z. melanoleuca* in being more robust, petioles glabrous, leaf blades longer and more triangular-hastate, up to 30 cm long and 30 cm across the basal lobes from tip to tip, lobes spreading, obtuse; spathe larger, cream, pale yellow or suffused with red, up to 14 cm long, tube sub-cylindric, closed; spadix with many (up to 12 rows) of ovules. Its habitat is at forest margins or in bush in partial shade and its flowering reaches its peak during December and January.

Nyasaland.—Namasi, 1897, *Cameron* s.n. (K!); Nivera Hill, Benson 81.

Southern Rhodesia.—Mashonaland, Six mile spruit, Salisbury, *Lady Evelyn Cecil* in K. 149; Melsetter. *Crook* in PRE 28828; Mount Silinda, *Obermeyer* in PRE 28827.

Transvaal.—Soutpansberg: 4½ miles N.E. of Louis Trichardt, *Codd* 8326; Entabeni Forestry Station, *Codd* 8400; four miles N. of Louis Trichardt on Messina road, *Admiraal* in PRE 28830; Pietersburg: one mile N. of Haenertsburg, *Codd* 8415; on farm Wellstead, *Thompson* in PRE 28826; Magoebaskloof, fld. Pretoria, *O'Connor* in PRE 28825; one mile E. of Haenertsburg, *Reynolds* 5806a; 5806b; Woodbush, *Mogg* in PRE 28832; Mohlakeng, Blaauwberg, *Codd* 9148; Letaba: Tzaneen, *Rogers*, 12501; Duivelskloof, *Haar* in PRE 28832; The Downs, *Murray*, PRE 28833; Barberton: Kaapmuiden, *Mogg* in PRE 28834; Louw's Creek, *Bragshaw* 110; eight miles S.E. of Barberton on Havelock Road, *Codd* 8159.

Swaziland.—Mbabane: Little Usutu valley, *Compton* 25405.

Cythna Letty

EBENACEAE

New Combinations in the Genus Diospyros

In Bothalia 7, 1: 17–19 (1958) a number of new combinations were made in the genus *Royena*. A short while after these notes were submitted for publication and too late for withdrawal, it was discovered that White (Oxford Univ. Forest Soc. Journ. 4, 6: 31–34, 1958) had come to the conclusion that the genus *Royena* could not be regarded as distinct from *Diospyros*. After some correspondence the author decided to follow White in uniting the two genera. Characters previously used for distinguishing *Royena* from *Diospyros* have proved to break down when the latter is studied on a worldwide scale. As pointed out in Bothalia l.c., *Royena* cannot be regarded as truly hermaphrodite, and the main difference given in the keys by various authors thus cannot be used. Attempts were made to associate a number of characters which in combination could be used to distinguish the two genera. However, as pointed out by White, this results in a classification in which some closely related species will fall in separate genera even though not closely related to the other species in the genus in which they are placed. For these reasons the genus *Royena* is now united with *Diospyros*. The following combinations are necessary.

Diospyros acocksii (de Winter) de Winter comb. nov. *Royena acocksii* de Winter in Bothalia 7, 1: 18 (1958).

Diospyros austro-africana de Winter nom. nov. *Royena hirsuta* L. Sp. Pl. ed. 1: 397 (1753).

(*a*) var. **austro-africana.** *Royena hirsuta* L. Sp. Pl. ed. 1: 397 (1753) non *Diospyros hirsuta* L. f. Suppl. 440 (1781); *Royena angustifolia* Willd. Sp. Pl. 2: 633 (1800) non *Diospyros angustifolia* Audib. ex Spach, Hist. Veg. Phan. 9: 405 (1843); *Diospyros hirsuta* Desf. in Ann. Mus. Par. 4: 449, t.62 f.2 (1805) non Linn. f. Suppl. 440 (1781).

(*b*) var. **rugosa** (E. Mey. ex A. DC.) de Winter comb, et stat. nov. *Royena rugosa* E. Mey. ex. A. DC. Prod. 8: 212 (1844) non *Diospyros rugosa* Sap. in Ann. Sc. Nat. 4, 17: 264, t.11 f.3 (1862) (fossil species). *Royena hirsuta* L. var. *rugosa* (E. Mey. ex A. DC.) Zahlbr. in Ann. Naturhist. Hofmus. Wien. 28: 397 (1903).

(*c*) var. **microphylla** (Burch.) de Winter comb. et stat. nov. *Royena microphylla* Burch. Trav. 1: 348 (1822) non *Diospyros microphylla* Bedd. Forest Man. 145 (1870); *Royena hirsuta* L. var. *microphylla* (Burch.) de Winter in Bothalia 7, 1: 18 (1958).

(*d*) var. **rubriflora** (de Winter) de Winter comb. nov. *Royena hirsuta* L. var. *rubriflora* de Winter in Bothalia 7, 1: 18 (1958).

As can be seen from the references under the varieties given above all the epithets available for re-combination in *Diospyros* were already occupied in this genus, and it was necessary to give a specific new name.

Diospyros galpinii (Hiern) de Winter comb. nov. *Royena galpinii* Hiern in F.C. 4, 1: 450 (1906).

Diospyros glabra (L.) de Winter comb. nov. *Royena glabra* L. Sp. Pl. 1: 397 (1753).

Diospyros glandulifera de Winter nom. nov. *Royena glandulosa* Harv. ex Hiern in Trans. Camb. Phil. Soc. 12: 89, t.2 (1873) non *Diospyros glandulosa* Lace in Kew Bull. 349 (1915).

Diospyros lycioides Desf. in Ann. Mus. Par. 6: 448, t.62 f.1 (1805).

(*a*) subsp. **lycioides.** *Royena lycioides* (Desf.) A. DC. Prod. 8: 214 (1844).

(*b*) subsp. **sericea** (Bernh.) de Winter comb. et stat. nov. *Royena sericea* Bernh. ex Krauss in Flora 27: 824 (1844); *Royena lycioides* (Desf.) A. DC. subsp. *sericea* (Bernh.) de Winter in Fl. Pl. Afr. 32, 3: t.1262 (1958).

(*c*) subsp. **guerkei** (O. Ktze.) de Winter comb. et stat. nov. *Royena guerkei* O. Ktze. Rev. Gen. Pl. 3, 2: 196 (1898); *Royena lycioides* (Desf.) A. DC. subsp. *guerkei* de Winter in Bothalia 7, 1: 17 (1958).

(*d*) subsp. **nitens** (Harv. ex Hiern) de Winter comb. et stat. nov. *Royena nitens* Harv. ex Hiern in Trans. Cambr. Phil. Soc. 12: 87 (1872); *Royena lycioides* (Desf.) A. DC. subsp. *nitens* (Harv. ex Hiern) de Winter in Bothalia 7, 1: 18 (1958).

Diospyros ramulosa (E. Mey. ex A. DC.) de Winter comb. nov. *Royena ramulosa* E. Mey. ex. A. DC. Prod. 8: 212 (1844).

Diospyros scabrida (Harv. ex Hiern) de Winter comb. nov. *Royena scabrida* Harv. ex Hiern. in Trans. Cambr. Phil. Soc. 12: 82 (1872).

(*a*) var. **scabrida.**

(*b*) var. **cordata** (E. Mey. ex A. DC.) de Winter comb. et stat. nov. *Royena cordata* E. Mey. ex A. DC. Prod. 8: 211 (1844) non *Diospyros cordata* (Hiern) Bakhuizen in Gard. Bull. Straits Settlm. 7: 167 (1933); *R. opaca* E. Mey. ex A. DC. Prod. 8: 211 (1844) non *Diospyros opaca* C.B. Cl. in Hook. f. Fl. Brit. Ind. 3: 567 (1882).

Both the epithets *cordata* and *opaca* are older than the epithet *scabrida*, but are already occupied in *Diospyros* hence the next available epithet *scabrida* was used. The epithet cordata has been used for the variety (*b*) to insure continuity and avoid more confusion although both varieties have cordate leaves.

Diospyros simii (O. Ktze.) de Winter comb. nov. *Royena simii* O. Ktze. Rev. Gen. Pl. 3, 2: 196 (1898).

Diospyros villosa (L.) de Winter comb. nov. *Royena villosa* L. Syst. Nat. 12, 2: 302 (1767).

var. **parvifolia** (de Winter) de Winter comb. nov. *Royena villosa* L. var. *parvifolia* de Winter in Bothalia 7, 1: 18 (1958).

D. whyteana (Hiern) F. White comb. nov. *Royena* whyteana Hiern in Trans. Linn. Soc. 2, 4: 25 (1894).

D. pallens (Thunb.) F. White comb. nov. *Royena pallens* Thunb. Prod. 80 (1794).

B. de Winter and F. White

GENTIANACEAE

Chironia

Chironia stokoei *Verdoorn* sp. nov., *C. jasminoidei* affinis sed ab ea et ab aliis speciebus stigmate peltato, praesertim floribus basi bi-bracteatis differt.

Suffrutex rigidus, adscendens, 30–50 cm altus; caules superne ramosi et foliolati inferne saepe nudi nodis prominentibus. *Folia* coriacea, paulo corrugata, elliptica nunc late nunc angustustate elliptica, interdum ovate vel lanceolati- elliptica, 1·7–3·5 cm longa, 0·5–1·8 cm lata, obtusa vel acuta, marginibus anguste revolutis. *Cymae* terminales, monochasiales, 3-florae vel ad florem solitarium reductae; pedicelli breves vel 0; *flores* basi bi-bractiati; bracteae 6–18 mm longae basi 1·3–4 mm latae, acuminatae, obtusae vel acutae. *Calyx* 9–16 mm longus infra medium lobatus; lobi a basi acuminati, obtusi vel acuti, obscure carinati. *Corolla* " magenta pink " (perraro alba), 2·2–2·8 cm longa; tubus submembranaceus, c. 1·2 cm longus in faucibus leviter constrictus apice ampliatus; lobi elliptici vel subrotundi, basi breviter cuneato-unguiculares, 1·2–1·8 cm longi, 0·8–1·1 cm lati. *Stamina* paulo infra fauces inserta

filamentis c. 1 cm longis, antheris c. 4 mm longis non tortilibus. *Ovarium* c. 1 cm longum, in stylum attenuatum; stylus quam ovarium brevior c. 8 mm longus; stigmate peltato apice crasse stigmatoso.

Cape.—Somerset West: Sneeuwkop, *Stokoe* 7986 (BOL); between Sneeuwkop and Landdrost Kop, *Stokoe* 9211 (BOL). Caledon: Kogelberg, *Stokoe* 1003 (PRE, holo.); 1003b; *Stokoe* in Bol. Herb. 17705; *Stokoe* in S.A. Museum Herb. 66894; Palmiet River mountains, *Stokoe* 982; mountains S. of Sir Lowry's Pass, *Stokoe* in S.A. Museum Herb. 66893; Klein River mountains *Stokoe* in S.A. Museum 64199.

Rigid ascending suffrutices, 30–50 cm tall; stems leafy and branched above, leafless below with prominent nodes, branches and leaves notate with shiny, microscopic, subcutaneous cells. *Leaves* coriaceous, somewhat corrugated on both surfaces, from broadly to narrowly elliptic, sometimes oblong-, ovate- or lanceolate-elliptic, 1·7–3·5 cm long, 0·5–1·8 cm broad, rounded or acute at the apex, margins narrowly revolute. *Cymes* terminal, monochasial, 3-flowered or reduced to a solitary flower; pedicels short or 0; *flowers* bi-bracteate at the base; bracts 6–18 mm long, 1·3–4 mm broad at the base, gradually narrowing to an obtuse or acute apex. *Calyx* 9–16 mm long, divided beyond the middle; lobes gradually narrowing from a broad base to an obtuse or acute apex, obscurely carinate. *Corolla* " magenta pink " (rarely white), 2·2–2·8 cm long; tube rather thin textured, slightly narrowed in the throat and widened at the mouth, about 1·2 cm long; lobes elliptic to subrotund and cuneate into a claw-like base, usually obviously longer than broad, 1·2–1·8 cm long, 0·8–1·1 cm broad. *Stamens* inserted just below the throat; filaments about 4 mm long; anthers about 4 mm long, not spirally twisted. *Ovary* about 1 cm long, attenuating into the style; style shorter than the ovary, about 8 mm long, stigma peltate, thickly stigmatose on top.

When revising the genus *Chironia* for the Flora of Southern Africa this species was found to be represented in three herbaria, the Marloth Herbarium (now in the National Herbarium, Pretoria), the Bolus Herbarium and the Herbarium of the South African Museum (now at the Herbarium of the National Botanic Gardens, Kirstenbosch). All the specimens, nine in number, were collected by Mr. T. P. Stokoe over a range of about 30 years. The earliest date was August 1924 and the most recent September 1953. The specimens all came from mountainous country in the Somerset West and Caledon districts. Unfortunately Mr. Stokoe although a great collector, never claimed to have an eye for recognizing species. It was after his 91st birthday (3.3.1959) and just after he had returned from his last trip to the Hottentots Holland that he was informed of this new species and that it was to be called after him. Had he lived he would most probably have made a point of investigating it for us. But his great usefulness to botanists came to a regretted end when he died in April 1959.

Chironia stokoei differs from all the other species with simple styles and a terminal stigmatic surface, in that the flowers are bi-bracteate at the base. In general it is nearest *C. jasminoides* but can be distinguished by the calyx-lobes which are never long attenuate at the apex and the shorter and broader leaves besides the bracts at the base of the flowers. In the prominent nodes on the almost leafless lower portion of the stem it resembles *C. arenaria*, but besides having basal bracts it differs in the corolla-lobes being longer than broad and the leaves usually broadly elliptic.

Chironia linoides Complex

C. linoides *Linn.* Aggregate species.

C. linoides *Linn.* subsp. **linoides.** Lectotype: specimen cited in Hort. Cliff. p. 54, No. 1. *C. linoides* Sp. Pl. ed. 1: 189 (1753); Prain in Kew Bull. 1908: 349 and 353 (1908); Hill & Prain in F.C. 4, 1: 1103 (1909). Syntypes: specimen cited in Hort. Cliff. p. 54, No. 1; specimen in Roy. Lugab. 433; and figure in Breyn. Cent. p. 175, t. 90/1678.

[The lectotype is nominated on the evidence of Prain (Kew Bull. 1908: 353) that the two specimens mentioned still exist and are both typical of the species. The first mentioned by Linnaeus is here chosen.]

Chironia linoides *Linn.* subsp. **nana** *Verdoorn*, nom. nov. Type: Cape Flats, *Ecklon* 642 (SAM, holo.!).
C. gracilis Salisbury ex Prain in Kew Bull. 1908: 293 (1908), non Michx. (1803). Syntypes: many specimens including *Ecklon* 642 from the Cape Flats.

C. linoides *Linn.* subsp. **macrocalyx** (*Prain*) *Verdoorn*, stat. nov., comb. nov. Lectotype: Cape Flats, *Ecklon* 644 (SAM, iso.!).
C. gracilis var. *macrocalyx* Prain in Kew Bull., 1908: 294 (1908). Syntypes: several specimens including *Ecklon* 644 from the Cape Flats.

C. linoides *Linn.* subsp. **emarginata** (*Jarosz*) *Verdoorn*, stat. nov.
C. emarginata Jarosz, Pl. Nov. Cap.: 11 (1821). Type: Peninsula, *Berg* s.n.

From the synonomy in the Flora Capensis (Vol. 4, 2: 1101–2, 1909) it can be seen that *C. emarginata* Jarosz and *C. gracilis* Salisb. ex Prain have both at some time or another been classified as *C. linoides* or a variety or form of that species or one of its synonyms. Hill and Prain separated these closely related specimens into four categories, *C. linoides*, *C. emarginata*, *C. gracilis* and *C. gracilis* var. *macrocalyx*. After examining the material now in the South African herbaria it was found that a fair percentage of this large number of specimens can, on sight, be sorted into one or other of these taxa. But there remains a significant assortment of intermediates (some may be hybrids) that do not fit exactly into any one of these. This seems to indicate that, to accommodate these intermediates, a far more workable treatment would be to look upon the whole group as belonging to one complex species, *C. linoides*, comprising four subspecies and their intermediates. The necessary combinations are made above.

The lectotype nominated for subsp. *macrocalyx* was selected because a duplicate of one of the syntypes of the species was seen in a South African herbarium and was found to answer very well to the original description.

Chironia palustris Complex

C. palustris *Burch.*, aggregate species.

C. palustris *Burch.* subsp. **palustris.** Type: Griquatown, *Burchell* 1925.
C. palustris Burch. Trav. 2: 226 (1824); Hill and Prain in F.C. 4, 1: 1106 (1909). Type: Griquatown, *Burchell* 1925.—var. *foliata* (Griseb.) Prain in l.l. (1909).—var. *radicata* (E. Mey.) Schoch in Bot. Centralbl. Beih. 14: 234 (1903). *Plocandra albens* E. Mey. Comm. 182 (1837). Type: Between Kachu and Zandplaat, *Drege*.—var. *radicata* E. Mey. l.c. (1837). Type: Mooyplaats, *Drege*. *P. palustris* (Burch.) Griseb. in D.C. Prod. 9: 43 (1845).—var. *foliata* Griseb. in l.c. (1845). Type: Caffraria, *Drege*.

C. palustris subsp. **rosacea** (Gilg) *Verdoorn*. Type; Cape, Pondoland, *Bachmann* 1038.
C. rosacea Gilg in Bot. Jahrb. 26: 104 (1899); Schoch in Bot. Centralb. Beih. 14: 229 (1903) partly as to Natal specimen; Hill and Prain in F.C. 4, 1: 1105 (1909).
C. maxima Schoch in Bull. Herb. Boiss. 2nd ser. 2: 1014 (1902). Type: Tugela Riv. *Wood* (Z).

C. palustris subsp. **transvaalensis** (*Gilg*) *Verdoorn*. Type: Lydenburg, *Wilm* 974.
C. transvaalensis Gilg in Bot. Jahrb. 26: 106 (1899); Schoch in Bot. Centralbl. Beih. 14: 227 (1903).

The specimens classified under *C. palustris* Burch., *C. rosacea* Gilg and *C. transvaalensis* Gilg, in the Flora Capensis are obviously closely related. The inflorescences

and flowers, especially, are very similar, the flowers varying only in size. After examining a large number of specimens in South African herbaria and investigating the living plants in the Transvaal the decision was made to reduce these taxa to subspecific rank. Reasoning on the following lines led to this decision.

Taking the species *C. palustris* and *C. transvaalensis* first, the main distinguishing features of the most southerly unit, *C. palustris*, are that it is usually smaller in stature, the basal leaves are persistent and the cauline usually much reduced while the taller Transvaal species has well developed cauline leaves and basal leaves which early disappear. In addition the anthers are strongly twisted in *C. palustris* and only slightly so in *C. transvaalensis*. This latter difference is usually a good auxillary distinction but being a matter of degree only, there are cases where it is not of any help.

It was noted from herbarium material that the areas of distribution of these two " species " overlap in the Transvaal. A spot near Kempton Park was visited to examine the living plants. In the turfy ground along a water course the tall *C. transvaalensis* was found with erect pairs of glaucous, linear-lanceolate cauline leaves and, at this stage, bearing no basal leaves. Nearby in a hardened patch of turf grew the smaller plant with a rosette of basal leaves pressed flat on the hardened ground and on the stem were remote pairs of much reduced leaves. The stamens were a degree more twisted than in the taller plants. The possibility of the hard condition of the ground being responsible for the differences was considered. But in the main area of distribution of the plants with basal leaves, that is the eastern Cape, no examples of plants without basal leaves have been found although the conditions of soil they seem to require probably exist in those regions too. Also in the central areas, north of Kempton Park, the plants are mostly without basal leaves and with well developed cauline leaves although hard patches of turf, in all probability, abound. So there are two sets of specimens separable on some vegetative features with separate centres of distribution. This seems to indicate that taxonomically subspecific status would be more appropriate for these two " species ". From the nomenclatural angle too this statue would be an advantage for in many cases where the lower portion of the plant was not collected it is difficult to decide whether the cauline leaves are small " well developed leaves " or rather large " reduced leaves ". This treatment would also provide a name for some specimens from the Victoria Falls which have the leaf characteristics of subsp. *palustris* but the anther-characters of subsp. *transvaalensis*.

The third " species " in this group for similar reasons is reduced to the same rank. *C. rosacea* Gilg agrees in habit with *C. transvaalensis* but differs in having larger flowers and broader leaves. These features are merely comparative but again the distribution is on the whole distinct, *C. rosacea* occuring in Natal and *C. transvaalensis* in the central regions. In Swaziland both are found and here intermediate specimens occur. In one case one portion of the same gathering has been identified as *C. transvaalensis* and another as *C. rosacea*. But on the whole the specimens are separable into the two categories.

From *C. palustris* *C. rosacea* differs in the well developed broad cauline leaves, the disappearance of the basal leaves and the larger flowers. It also has a separate centre of distribution and so bears a similar relationship to *C. palustris* as does *C. transvaalensis*. The necessary combinations for the subspecies are made above.

Chironia purpurascens Complex

C. purpurascens (*E. Mey.*) *Benth. and Hook. f.*, aggregate species.

C. purpurascens (*E. Mey.*) *Benth. and Hook. f.*, subsp. **purpurascens.** Type: Natal, near Umkomaas, *Drege* 4923.

C. purpurascens (E. Mey.) Benth. and Hook. f., Gen. Pl. 2: 805 (1876); Hill and Prain in F.C. 4, 1: 1108 (1909).—var. *tysonii* (Gilg) Prain in Kew Bull. 1908: 350 (1908).

—var. *impedita* Prain l.c. Type: *Krook* 2028. *C. bachmannii* Gilg in Bot. Jahrb. 26: 103 (1898). Type: Pondoland, *Bachmann* 1037. *C. tysonii* Gilg l.c: 104 (1898). Type: near Clydesdale, *Tyson* 1290. *Plocandra purpurascens* E. Mey! Comm. 182 (1895).

C. purpurascens (*E. Mey.*) *Benth. and Hook f.* subsp. **humilis** (*Gilg*) *Verdoorn* stat. nov. Type: Pretoria, Aapies Riv. Zeyher 1193.

C. humilis Gilg in Bot. Jahrb. 26: 105 (1899); Baker and Brown in F.T.A. 4, 1: 555 (1904); Hill and Prain in F.C. 4, 1: 1107 (1909).—var. *wilmsii* (Gilg) Prain in Kew Bull. 1908: 350 (1908); Hill and Prain in F.C. 4, 1: 1107 (1909).—var. *zuluensis* Prain in Kew Bull. 1910: 55 (1910). Syntypes: Ginginhlovo *Wylie* in Herb. Wood 11, 355; without precise locality, Mrs. *McKenzie* s.n. *C. wilmsii* Gilg in Bot. Jahrb. 26: 105 (1899). Type: Bronkhorstspruit, *Wilms* 973.

A study of the species of Chironia shows that *C. purpurascens* (E. Mey.) Benth. and Hook. f. and *C. humilis* Gilg are more closely related to each other than to any of the rest of the species. In the Flora Capensis this is borne out by Hill and Prain who put these two "species" in a section by themselves. To the distinguishing characters which they use for the section, namely the deeply cut calyx, short corolla-tube, distinctly spirally twisted anthers and pointed fruits, may be added the following features shared by the two "species", the deep colour of the flowers (usually magenta pink); the acicular apical half of the calyx-lobes and bracts; and the central flowers of the cymes usually having a much shorter pedicel than those of the lateral. The features which separate these units are: the smaller stature of *C. humilis*, about 30 cm as against over 50 cm tall; the pedicel of its central flower usually being under 6 mm long as against being up to 25 mm long; and flowers frequently with a pair of bracts near the base of the calyx while in the taller plants they are only rarely present. These differences are principally in the size of the plant itself or certain parts of it; but the main area of distribution of the two groups is distinct; the taller plants come from the extreme eastern Cape, Natal, and Swaziland while the smaller plants are recorded from Zululand (northern Natal), the Transvaal and northwards to Southern Rhodesia.

These findings indicate that the relationship which the two groups bear to each other is rather subspecific than specific and *C. humilis* is therefore here reduced to a subspecies under *C. purpurascens* which is the older name.

Enicostemma

Enicostema hyssopifolium (*Willd.*) *Verdoorn* comb. nov. Type: specimen 328.30 (Fabricius) in Linnean Herbarium (L, lecto.; PRE, photo.).

Exacum hyssopifolium Willd. Spec. 1: 640 (1798). Name for Gentiana verticillata (non Linn.) Linn. f.

Gentiana verticillata (non Linn. 1753) Linn. f. Supple.: 174 (1781) applied when naming a Fabricius specimen from India; Vahl, Symb. 3: 46 (1794) partly as to Indian and Arabian references. *G. verticillaris* (sic) Linn. var. β. Retz. Obs. Bot. 2: 15 (1781) based on a Konig specimen.

Hippion hyssopifolium (Willd.) Spreng. Syst. 1: 589 (1824).

Enicostema littorale Blume, Bijdr. 848 (1826). Type: *Blume*, Java.

E. verticillare (Retz.) Baill. Hist. Pl. 10: 131 (1891) partly.

E. verticillatum Engl. in Pfl. Cat. Afr. C: 313 (1895) as to specimens cited.

Lepinema verticilata Raf., Fl. Tellur, 3: 26 (1837) partly as to Vahl reference.

Adenema hyssopifolium (Willd.) G. Don. Gen. Syst. 4: 201 (1837).

Slevogtia verticillata D. Don. in Trans. Linn. Soc. 17: 532 (1837) nom illeg. based on Gentiana verticillata Linn. fil.; *S. orientalis* Griseb. in DC. Prod. 9: 65 (1845), nom illeg.

Hippionum verticillatum O. Ktze. Rev. Gen. Pl. 428 (1891) for the greater part, excluding the American reference.

Lectotype: I nominate the Fabricius specimen No. 328.30 in the Linnean Herbarium as the lectotype of *Enicostema hyssopifolium* (Willd.) Verdoorn. Willdenow's first reference under *Exacum hyssopifolium* is " Linn. f. Suppl. 174 ", where the Fabricius specimen from India is described.

The first record of this species was that of Linnaeus filius in the Supplementum 1781 when describing a Fabricius specimen from India. It was classified by him as *Gentiana verticillata* Linn., an American species. Willdenow in 1798 recognized this as an error and not only distinguished between the American and Indian specimens but transferred them both to the genus *Exacum*. The American plants he placed under *Exacum verticillatum* (L.) Willd. and gave the name of *Exacum hyssopifolium* to the specimen recorded by the younger Linnaeus in Supplementum. No mention is made by Linnaeus or Willdenow of the unusual double hooded gland at the base of the filaments. This has proved to be a diagnostic character and in 1826 Blume described the genus *Enicostema* meaning " singular stamen " for a specimen from Java. Independently three other genera were described to take the same taxon, but *Enicostema* is the earliest legitimate generic name. This name is therefore combined above with the earliest legitimate specific epithet " hyssopifolium " of Willdenow.

I. C. Verdoorn

Sebaea

Sebaea fourcadei *W. Marais* sp. nov. S. ramosissimae affinis sed inflorescentia compactiore, calycis segmentis stramineis fragilis, corollae lobis quam tubum longioribus differt.

Herba annua, gracilis, erecta ad 25 cm alta. *Caulis* simplex vel basi ramosus. *Folia* ovato-orbiculata vel superne ovata, ad 1 cm longa, 1 cm lata, obtusa vel subacuta, paribus paucibus, internodiis longis. *Inflorescentia* corymbosa, pauci- vel pluriflora. *Calyx* 5-fidus; segmenta 4·75–5 mm longa, 1–1·5 mm lata, lanceolata vel elliptico-lanceolata, acuminata mucronata, carinata, marginibus membranaceo-opacis, fragilibus. *Corolla* flava; tubus 3–4 mm longus; lobi 2·75–3·5 mm longi, 1–1·25 mm lati, anguste-elliptici vel anguste ovato-elliptici, oblanceolati, obtusi, nonnumquam leviter cucullati. *Filamenta* 0·25 mm longa in faucibus inserta; anthera 0·875–1·25 mm longa, glandulis 3 parvis flavis globosis breviter stipitatis ornata. *Stylus* 2·75–3·75 mm longus, infra vel plus minus medio callo instructus stigmate capitato 2-lobato.

Cape.—Knysna: Belvedere, *Duthie* 1175 (K). Humansdorp: Geelhoutboom, *Fourcade* 4880 (K, holo!).

Slender, erect, annual herbs, simple or branched near the base, up to 25 cm high. *Leaves* up to 1 cm long and 1 cm broad, ovate-orbicular or the upper ones ovate, obtuse or subacute, in relatively few pairs, the lower ones, soon dying off; internodes long. *Inflorescence* corymbose, few to several flowered. *Calyx* of 5 segments each 4·75–5 mm long, 1–1·5 mm broad, lanceolate or elliptic-lanceolate, acuminate-mucronate, their sides membranous-opaque, brittle and strawlike when dry, keeled. *Corolla* yellow; tube 3–5 mm long; lobes 2·75–3·5 mm long, 1–1·25 mm broad, narrowly-elliptic or narrowly ovate-elliptic to oblanceolate, rounded, sometimes slightly cucullate. *Filaments* 0·25 mm long, inserted in the corolla-sinuses. *Anthers* 0·875–1·25 mm long, each with three small round, shortly stipitate, pale yellow glands. *Style* and *stigma* 2·75–3·75 mm long, with a stigmatic swelling below or near the middle; stigma capitate, 2-lobed.

S. capitata *Cham. et Schlechtdl.* var. **sclerosepala** (*Schinz*) *Marais*, stat. nov.

Basionym: *S. sclerosepala* Gilg ex Schinz in Mitt. Geogr. Ges. Lübeck 17: 23 (1903).

S. micrantha *Cham. and Schlectdl.* var. **intermedia** (*Cham. and Schlechtdl.*) *Marais*, comb. nov.
Basionym: *S. cordata* var. *intermedia* Cham. and Schlechtdl. in Linnaea 1: 191 (1826).

S. Zeyheri *Schinz* subsp. **acutiloba** (*Schinz*) *Marais*, stat nov.
Bassionym: *S. acutiloba* Schinz in Bull. Herb. Bois. 3: 412 (1895).

S. Zeyheri *Schinz* subsp. **cleistantha** (*R. A. Dyer*) *Marais*, stat. nov.
Basionym: *S. cleistantha* R. A. Dyer in K.B. 1933: 461.

S. pentandra *E. Mey* var. **burchellii** (*Gilg*) *Marais*, stat. nov.
Basionym: *S. burchellii* Gilg in Bot. Jahrb. 26: 89 (1898).

S. sedoides *Gilg* var. **confertiflora** (*Schinz*) *Marais*, stat. nov.
Basionym: *S. confertiflora* Schinz in Mitt. Geogr. Ges. Lübeck 17: 51 (1903).

S. sedoides *Gilg* var. **schoenlandii** (*Schinz*) *Marais*, stat. nov.
Basionym: *S. schoenlandii* Schinz in Bull. Herb. Boiss sèr 2, 6: 741 (1906).

Lectotypes in Sebaea

Sebaea laxa *N.E. Br.* in Kew Bull. 1901: 128 (1901).
Syntypes: *Burchell* 7089 and *Galpin* 4337. Lectotype: *Galpin* 4337 (K).

On the sheet of *Galpin* 4337 which N. E. Brown examined there are some dissected flowers indicating that this specimen was studied in more detail than *Burchell* 7089.

Sebaea compacta *Hill.*
Lectotype: *Barber* 21 (K). Selected because it is the best of the syntypes as far as state of preservation and amount of material is concerned.

S. Zeyheri *Schinz* subsp. **acutiloba** (*Schinz*) *Marais.*
Lectotype: *Schlechter* 3045 (K).

Schinz cites two specimens with his description of *S. acutiloba* in Bull. Herb. Boiss 3: 415 (1895), namely, *Schlechter* 3045 and *Wood* 4950, both from Clairmont, Natal. As Schlechter's specimens are usually represented in several herbaria and there is only a fragment of *Wood* 4950 in the Kew Herbarium, I select the Kew sheet of *Schlechter* 3045 as lectotype.

Belmontia and Exochaenium synonymous with Sebaea

In the Flora Capensis (4, 2: 1057, 1909) Hill and Prain follow Schinz and sink *Belmontia* E. Mey. under *Sebaea* R. Br. while maintaining *Exochaenium* Griseb. as a distinct genus. Phillips in his Genera of South African Flowering Plants (1951) follows Bentham and Hooker who treat *Exochaenium* as being synonymous with *Belmontia*, which genus they maintain as distinct from *Sebaea*.

In my work on the " Flora of Southern Africa ", I have come to the conclusion that both *Belmontia* and *Exochaenium* are inseparable from *Sebaea* and they will be treated as synonyms of the latter genus in the " Flora ". Some of the reasons that led to this decision are as follows: The main distinguishing features between *Belmontia* and *Exochaenium* collectively on the one hand and *Sebaea* on the other, are, the presence in the former group of disc-glands between the calyx and the corolla, the style being without a two glandular swelling and the stamens included in the corolla-tube instead of being inserted in, or shortly below, the sinuses of the lobes and exserted from the tube. In several instances these characteristics have proved to be diagnostically unreliable. For instance, in the species *Sebaea thomasii*, disc-glands are sometimes present and sometimes not. Then again in *S. micrantha* and *S. exacoides*, while the stamens are included in the corolla-tube, a characteristic of *Exochaenium* and *Belmontia*, glandular swellings are present on the styles, features of *Sebaea*.

W. Marais

Streptocarpus rimicola *Story*, sp. nov., *S. pumilo* Burtt affinis, sed stylo breviore et floribus albis differens.

Herba acaulis unifoliata, raro folio altero minimo. *Folium* plerumque c. 4 × 2 cm (1·5 × 1–6·5 × 2·5), late ovatum vel angustum et acuminatum, leviter serratum, chartaceum vel coriaceum, utrinque villis eglanduliferis, venis supra impressis subtus prominentibus, hypocotylo plerumque minutissimo, raro ad 1 cm longo. *Inflorescentia* villis glanduliferis et eglanduliferis, ad 7 cm alta, plerumque 3–4. *Pedunculi* numero ad 4 plerumque solitarii, quisque ad 9 plerumque 2–3 flores ferens. *Bracteae* minutae. *Pedicelli* 1 ad 2·5 cm longi interdum ramosi. *Calyx* ad basin partitus, lobis 2 × 0·5 mm. *Corolla* alba 1 cm longa; tubus cylindratus basi saccatus, leviter supinus, 8 mm longus 2–3 mm diam., intus glaber (crista villorum eglanduliferorum pellucidorum vel purpureo-tinctorum super antheris excepta); limbus vix obliquus, lobis orbicularibus c. 3 mm longis et latis. *Orbis* annularis leviter lobatus viridis. *Androecium* staminibus corollae basi ab 1 mm insertis; filamenta glabra pellucida 4 mm longa; staminodia 3, pariter basi ab 1 mm inserta, 2 c. 1 mm longa, 1 brevius. *Gynoecium* ovario 2–2·5 mm longo; stylus 3–3·5 mm longus, apicem versus glaber et subito deflexus; stigma capitatum, paulum ultra antheras eminens. *Capsula* robustior, 8–10 mm longa, ad 2·5 mm lata; stylus persistens 3–3·5 mm longus.

Transvaal.—Warmbaths district: Farm Groothoek 1246, western extremity of Waterberg mountains, steep south-facing mountain side, under overhanging ledges, 6,000 ft., *Codd* 3974; *Codd* 6486 (PRE, holo.); *Story* 6517.

A stemless unifoliate herb, rarely with a second much smaller leaf. *Leaf* dark green above, paler and sometimes reddish below, usually about 4 × 2 cm (in flowering specimens ranging from 1·5 × 1 to 6·5 × 2·5), sometimes broadly ovate, sometimes narrowly oblong and acuminate, often withered at the tip, slightly serrate, chartaceous to coriaceous, with non-glandular hairs on both surfaces, veins sunken above, prominent below, hypocotyl usually not noticeable, rarely up to 1 cm long. *Inflorescence* with glandular and non-glandular hairs, up to 7 cm high but usually 3 to 4. *Peduncles* up to four but usually solitary, each bearing up to nine but usually two or three flowers. *Bracts* minute. *Pedicels* 1–2·5 cm long, sometimes branched. *Calyx* lobed to the base, lobes 2 × 0·5 mm. *Corolla* white, 1 cm long; tube saccate at base, slightly curved upwards, 8 mm long, 2–3 mm diam., glabrous within except for a patch of light purple or colourless 2-celled smooth-walled; eglandular hairs above the anthers; limb scarcely oblique, lobes rounded, about 3 mm long and as wide. *Disc* annular, fleshy, slightly lobed, light green. *Androecium* with stamens inserted 1 mm from the base of the corolla-tube; filaments glabrous, colourless, 4 mm long; anthers colourless; staminodes 3, inserted 1 mm from the base of the tube, two of them about 1 mm long, the third smaller. *Gynoecium* in freshly-opened flower with ovary 2–2·5 mm long; style 3–3·5 mm long, glabrous near the tip which is sharply bent down; stigma capitate, projecting a little beyond the anthers. *Capsule* erect, fairly stout, 8–10 mm long, up to 2·5 mm wide; style persistent, 3–3·5 mm long.

The highest peak in the Waterberg (6,841 feet) is at the western edge of the range, which at this point falls abruptly away into the sandy flats of the north-western Transvaal and the Bechuanaland Protectorate. According to available records, *Streptocarpus rimicola* occurs only on this peak, and even here the plants are apparently restricted to the southern aspect and to the sheer cliffs which make up the last three hundred feet or so. There is an annual rainfall of about 30 inches which falls mainly in summer, but the plants depend less on direct rainfall than on seepage and mist, for they grow mostly in deep shelter under rock ledges. They have so far not been found near the bottom of the cliffs, although there are as many crevices and ledges there and these provide apparently ideal conditions for their growth. Presumably there is less mist

near the bottom and therefore not enough moisture for them. It was interesting to find that the only other member of the genus recorded from this locality also has a very small altitudinal range. Below the cliffs are steep grassy slopes covered with boulders of all sizes, and a little way above the trees which clothe the lower slopes of the mountain is a narrow zone of *Streptocarpus vandeleuri* growing on the shady side of the boulders wherever there is shelter and a little soil. The plants occupy about 200 yards of mountain slope, roughly 300 feet of altitude.

FIG. 1.—*Streptocarpus rimicola*; 1, front view of flower; 2, side view, both × 8.

Streptocarpus rimicola is often massed together in small irregular patches, but as it blooms sporadically it does not make a show. By about the middle of April the flowering season is over. The flower is tilted upwards and has the anthers only lightly connivent and often separate by the time it is fully open.

The plant is about the same size as *Streptocarpus pumilus*, and closely related. Flower colour is a rather unreliable character in the genus but the specific rank of *Streptocarpus rimicola* appears justified by the other differences which are set out in tabular form at the end of this paper. The hypocotyl is as a rule imperceptible when the plant is growing and the bracketed figure in the table gives the length of the only one of that size seen among the hundreds of plants which were examined. Our only

specimen of *Streptocarpus pumilus* indicates also that it has a more slender capsule than *Streptocarpus rimicola* and a narrower corolla-tube. This last point was confirmed by Mr. B. L. Burtt, the author of *Streptocarpus pumilus*, who kindly reported on a specimen sent to him.

Streptocarpus pumilus	*Streptocarpus rimicola*
1. Flower mauve.	1. Flower white.
2. Hypocotyl up to 3 cm long.	2. Hypocotyl less than 0·5 cm long (rarely up to 1 cm).
3. Stamens inserted 6 mm from base of corolla tube.	3. Stamens inserted 1 mm from base of corolla tube.
4. Ovary 2 mm long, style 8 mm long.	4. Ovary 2–2·5 mm long, style 3–3·5 mm long.

R. Story

GRAMINEAE

Digitariella *de Winter*, genus novum, affinis *Digitariae*, sed ita differt: spicula basi in pseudo-callum producta, gluma inferior ab superiore internodio distincto separata, gluma superior et lemma inferius in apicem attenuatum subaristatum sensim producta.

Annua, culmis ramosis ascendentibus, nodis villosis, vaginis nodis superantibus, ligula brevi truncata membranacea, laminis linearibus vel lineari-lanceolatis glabris margine crenulatis. *Inflorescentia* 2–3 racemis spiciformibus digitate confertibus. *Spiculae* binae vel solitariae. *Gluma* inferior parva, squamiformis, enervis, longe infra glumam superioram inserto internodio distincto separata. *Gluma* superior anguste lanceolata 3 mm longa et 0·75 mm lata, sensim in apicem subaristatum 2·5 mm longum producta, 7-nervis cum linea pilorum inter nervos uterque latere costae mediani et ad margines. *Flos inferior* ad lemma reductus. *Lemma* inferius 3 mm longum 0·75 mm latum anguste lanceolatum 5-nerve, haud aristatum. *Flos superior* fertilis, lemmate coriaceo lanceolato-naviculari 2·5 mm longo, breve mucronato, palea coriacea naviculari 2-nervi, lodiculis truncatis, cuneatis enervibus. *Stamina* 3, antheris basi obtuse sagittatis oblongo-ellipticis 0·5–0·6 mm longis, ovario glabro stylis distinctis stigmatibus plumosis. *Caryopsis* libera ambitu oblanceolato-elliptica; embryo 1/3–3/5 longitudinis caryoptidis; hilum subbasale, ellipticum.

Species unica, Africae tropicae austro-orientalis incola.

Digitariella remotigluma *de Winter*, sp. nov.

Annual with ascending branched culms, often rooting at the nodes. *Nodes* sparsely villous. *Leafsheaths* exceeding the nodes, striate, slightly keeled, glabrous. *Ligule* a short membrane. *Collar* glabrous. *Leafblade* linear to linear-lanceolate, glabrous; margin distinctly undulate-crenulate. *Inflorescence* consisting of 2–3 digitately arranged spikelike racemes; racemes 2·5–6 cm long. *Spikelets* usually in pairs, one shortly pedicelled, the other pedicel longer, very occasionally single, abaxial in relation to the axis. *Lower glume* a small nerveless, membranous scale, distant from the upper, clasping the calluslike prolongation of the base of the spikelet. *Upper glume* produced downwards into the callus, connate with it, narrowly lanceolate, gradually produced into an awn-like apex 2–2·5 mm long, 7-nerved, body of the glume about 3 mm long and 0·75 mm wide, nerves on each side of the midnerve approximate, with a line of hairs between them and along the margin; margins somewhat inflexed. *Lower floret* reduced to the lemma. *Lower lemma* narrowly lanceolate, 3 mm long and 0·75 mm wide, acuminate, not awned, 5-nerved, hairy between the lateral nerves, and on the margins.

Upper floret fertile. *Upper lemma* coriaceous, white, lanceolate in outline, boat-shaped, 2·5 mm long and 1 mm wide when spread out, acuminate and shortly mucronate. *Palea* coriaceous, lanceolate in outline, boat-shaped with inflexed margins, 2-nerved. *Lodicules* truncate, cuneate, nerveless. *Stamens* 3; anthers bluntly saggitate at the base, oblong-elliptic in outline, about 0·5–0·6 mm long. *Ovary* glabrous; styles distinct; stigmas plumose, purple. *Caryopsis* tightly enclosed by the lemma and palea but free, oblanceolate-elliptic, whitish, opaque; embryo about 1/3–3/5 the length of the grain; hilum sub-basal, narrowly elliptic, brownish.

South West Africa.—Okavango Native Territory: Junction of Mpungu Omuramba and Okavango River between Tondoro and Lupala, soft annual with yellow-green inflorescences on swampy edges of lagoon, 17–12–1955, B. de Winter No. 3978 (PRE, holo; K,M,B, BM, SRGH, Windhoek, iso.); River flats below visitors camp at Runtu, peaty black soil, annual grass growing in moist places on floodplain of river, 22–12–1955, B. de Winter No. 4037. Eastern Caprivi: Mpilila Island, frequent on banks of Zambesi River, Killick and Leistner 3370.

This interesting new genus belongs in the somewhat loosely defined group of the Paniceae sometimes referred to as the *Digitariastrae*. The *Digitariastrae* are characterised as follows: fertile valves thinly chartaceous to cartilaginous with margins hyaline to subhyaline, inflexed but not inrolled, and the position of the spikelet abaxial in relation to the rhachis (upper glume and upper lemma with their surfaces adjacent to the axis).

The closest affinity of *Digitariella* is *Digitaria* as implied by the name. It agrees with *Digitaria* in the loosely paired spikelets, the digitate inflorescence and the approximate lateral nerves of the lower lemma with a line of hair between them. The main differences are the elongated calluslike prolongation of the base of the spikelet and the much attenuated awnlike apices of the lower glume and lemma.

It also agrees in general in the structure of the spikelets with genera such as *Oryzidium* and *Louisiella*. These genera however differ in the adaxial orientation of the spikelet, that is the lower glume and lower lemma are turned towards the axis. Though allied to these genera the affinity is obviously less close than to the members of the *Digitariastrae*.

The basal prolongation of the spikelet of *Digitariella* is not a true callus but is formed by the fusion of the base of the upper glume and rhachilla. This calluslike prolongation strongly reminds one of that found in the South American genus *Chaetium* from which *Digitariella* differs by the orientation of the spikelet and by the minute remote lower glume. In *Chaetium* the callus is formed by the fusion of the rhachilla and the bases of both the glumes. The glumes moreover are large and equal or exceed the spikelets in length. *Chaetium* cannot therefore be regarded as very closely allied to *Digitariella*.

Eragrostis aristata *de Winter*, sp. nov., aff. *E. crassinervi* Hack. sed lemmatibus 3-lobatis, nervo mediano in aristam brevem terminanti, nervis lateralibus in mucrones breves excurrentibus, omnibus nervibus et carinis palearum spinis brevibus hyalinis scaberrimis, gluma superiore 3-nervata.

Annua 30–75 cm alta. *Vaginae* internodiis breviores, carinatae, carinis cum glandulis minutis demersis vel crateriformibus. *Ligula* pilis longis hyalinis ciliata. *Lamina* infra galbra, nervis glandulosis scabridis exceptis. *Panicula* ad 30 cm longa 15 cm lata, ramis primariis patentibus, spiculis in ramis secundariis, subdense aggregatis, ramis rhachidibusque scabridis glandulosis. *Spiculae* breve pedicellatae vel subsessiles ca. 6 mm longae 4 mm latae, 5–12-florae, rhachilla persistenti, glumis inequalibus, inferioribus 1-nervatis, superioribus 3-nervatis, frequenter plusminusve 3-lobatis, ad nervos glandulosis, lemmatibus 3-lobatis, nervo mediano in aristam ad 1·5 mm longam excurrenti, nervis lateralibus in mucrones terminantibus, nervis scabridis glandulosis,

paleis carinis scabridis bicarinatis. *Stamina* 3, antheris oblongis 0·5–0·6 mm longis. *Ovarium* glabrum. *Lodiculae* truncatae glabrae. *Caryopsis* oblonga lateraliter leviter compressa.

South West Africa.—Omaruru: Namib, Brandberg, annual, along river bed, abundant, *Schweickerdt* 2252 (PRE, holo. K, iso); Brandberg, Hungarob ecke, *Wiss* 1504; Brandberg valley, *Liebenberg* 5019.

Annual, 30–75 cm high, with soft erect or geniculate 2–4-nodes culms. *Sheaths* pallid, fairly tight, usually shorter than the internodes, soft, glabrous, distinctly ribbed with small sunken or crateriform glands on the ribs especially below the collar and above the nodes. *Ligule* a fringe of long hyaline bristly hairs; auricles glabrous. *Leafblade* flaccid, glabrous below, with sunken glands on the nerves, scabrid on the nerves on upper surface, usually flat; margin scabrid and with small crateriform glands. *Panicle* exserted when mature, up to 30 cm long and 15 cm wide, primary branches spreading, not whorled, single or opposite, spikelets clustered on the short secondary branchlets, axis and branches ribbed with small crateriform glands on the ribs and scabrid with short hyaline spines. *Spikelets* shortly pedicelled or subsessile on the secondary branchlets, about 6 mm long and 4 mm wide, green to deep purple in colour, 5–12-flowered, breaking up from below, paleas usually persistent on the rhachis. Florets hermaphrodite. *Glumes* unequal to subequal, lower one-nerved, about 1 mm long, upper 3-nerved, often somewhat tri-lobed at apex, 1–1·75 mm long, usually with raised glands on or near the nerves, nerves usually scabrid. *Lemmas* tri-lobed, 2·3·5 mm long, ovate, 3-nerved, midnerve excurrent into an awn up to 1·5 mm long, lateral nerves very shortly awned to mucronate, body of lemma 1·5–2 mm long, strongly keeled along midrib and lateral nerves, scabrid on the nerves and with small raised glands. Palea strongly curved, bi-keeled, keels scabrid with hyaline spines. *Stamens* 3; anthers oblong, 0·5–0·6 mm long, yellow. *Ovary* glabrous; styles free; stigma plumose. *Lodicules* somewhat fleshy, truncate, glabrous. *Caryopsis* oblong, somewhat laterally compressed, pale to deep brown; embryo about 1/2–3/5 the length of the caryopsis; hilum punctiform, basal.

This species has so far only been collected in the vicinity of the Brandberg in South West Africa. It can be expected to occur in the marginal Namib desert right up to the Kunene and possibly a little way beyond into Angola, this area offering similar ecological conditions as those encountered at the Brandberg.

At the first glance *E. aristata* can hardly be recognised as a species of Eragrostis, especially when the specimens are not fully mature. It is so obviously related with *E. crassinervis* Hack. however that including it in the same genus as the latter is the only logical way to treat it. *E. crassinervis* has the nerves of the lemmas excurrent into very short mucros, and the awns of *E. aristata* can only be regarded as a further development in this direction. Except for the awned lemmas and 3-nerved upper glume, all the other characteristics agree with those of typical Eragrostis species. Three-nerved glumes occur also in *E. bergiana*, *E. truncata* and several other species.

Eragrostis glandulosipedata *de Winter*, sp. nov., aff. *E. porosae* Nees, sedspiculis majoribus, lemmatibus latioribus et longioribus, pedicello glanduloso differt, necnon affinis *E. omahekensi* de W. sed ab ea lemmatibus brevioribus apice obtusis vel subobtusis recedit.

Annua vel *subperennis* 4–100 cm alta. *Culmi* erecti geniculati vel adscendentes, simplices vel ramosi, 2–4 nodosi. *Vaginae* internodiis breviorae, laxae, glabrae vel sparse pilosae, costis glandulosis. *Ligulae* dense ciliatae. *Laminae* flaccidae plerumque planae, glabrae vel sparse pilosae. *Panicula* angusta, plus minusve contracta vel laxa, ramis basi verticillatis apicem versus solitariis vel binis vel ternis plerumque prope basim glandulis immersis. *Spiculae* 6–10-florae, 4–6 mm longae 1·5–2 mm latae, glumis inaequalibus, 1-nervatis acutis, carinis scabridis. *Stamina* 3, antheris 7–10 mm longis. *Caryopsis* oblonga vel late oblonga, subtranslucens.

Transvaal.—Potgietersrus: Roedtan, *Barenbrug* s.n.; Singapore Cash Store, Grass Valley, *de Winter* 2332 (holotype, PRE, isotype, K, BM, M, B, SRGH, EA, BOL); Roedtan, *de Winter* 2224; Roedtan, *de Winter* 2290.

South West Africa.—Grootfontein: Awagobib, *Volk* A. 11; Asis, *Volk* A. 60 and 656; Hairabib, *Volk* 504; Auros, *Volk* 616 and 633 (635); Ossa, *Volk* 669; 23·5 m, E. of Otavi on rd. to Grootfontein, *de Winter* 2865; Rietfontein, *Schweickerdt* 2091; Kumkauas, *Kinges* 2797; Auros, Schoenfelder S 563. Okahandja: Teufelsbach, *de Winter* 2694; Okakuja, *Grossarth* s.n.. Tsumeb: Etosha Pan, *de Winter* 2965; Between Tsumeb and Namutoni, *de Winter* 2950. Outjo: Gainatzeb, *Volk* 2670.

Kenya.—Nairobi, Bogdan A.B. 3119 (K).

Annual 4–100 cm high, culms erect, geniculate-ascending or the lower internodes prostrate but not rooting at the nodes, simple or branched, 2–4 noded, internodes hollow, compressible, with a glandular ring just below the nodes, ultimate internode long exserted when mature. *Sheaths* shorter than the internodes, lax, glabrous or hairy with bulbous-based hairs, shiny, glandular on the ribs, especially on the midrib above the node and below the junction of the blade and sheath. *Collar* with a fringe of stiff hyaline hair. *Ligule* a short dense fringe of hair. *Leafblade* linear, flat or somewhat rolled, distinctly veined below, striate above, scaberulous on the striae, glabrous or sparsely hairy, glandular on the midrib or without glands, tapering to a fine point. *Panicle* rather dense or lax, narrowly ovate-oblong to narrowly-oblong, branches whorled at the base, three or two together or single towards the apex, not spreading and somewhat appressed to the rhachis; rhachis glabrous, often glandular below the lower whorls of branches. *Spikelets* pedicelled, 6–10-flowered, 4–5 mm long and 1·5–2 mm broad, blackish or greenish grey to ashgrey in colour; rhachilla tardily disarticulating between the florets. *Florets* awnless, hermaphrodite. *Glumes* 1-nerved, unequal, lanceolate in side view, membranous, acute, scabrid on the keels; lower about 1 mm long, upper about 1·5 mm long. *Lemmas* 1·5–1·7 mm long, broadly elliptic to broadly oblong-ovate, scabridulous especially near the apex, 3-nerved, nerves rather prominent, apex obtuse to subacute. *Palea* as long as lemmas, membranous, hyaline, bi-keeled, scaberulous. *Lodicules* truncate, cuneate, small. *Stamens* 3; anthers 0·7–1 mm long, cultrate, yellow. *Ovary* glabrous; styles free; stigmas 2, plumose. *Caryopsis* oblong to broadly oblong, 0·6–0·9 mm long, pallid to brownish, semitranslucent; embryo half the length of the grain, brownish green; hilum punctiform, basal.

E. glandulosipedata has an interesting distribution. It is common in the Grootfontein, Tsumeb and Outjo districts of South West Africa and has also been recorded from the sandy parts of the Springbuck Flats near Roedtan and Grass Valley in the Transvaal. One specimen which undoubtedly also belongs here, was collected by Bogdan at Nairobi, Kenya. Although very interrupted this distribution follows a pattern observed in the case of a number of other species, such as *Tetrapogon tenellus*, *Eragrostis pseudo-sclerantha* and others. Like in many other annual grasses there is a great variation in the size of the individuals of this species. In good years they may reach a height of over 1 m while the author has collected specimens barely reaching 10 cm growing on dry brackish soils at Namutoni. The spikelets however remain characteristic and show little variation even in size.

Eragrostis kingesii *de Winter*, sp. nov., aff. *E. procumbenti* Nees, sed ab ea spiculis minoribus, lemmatibus brevioribus, carinis et nervis lateralibus scabridioribus recedit.

Annua, decumbens vel suberecta, parva. *Culmi* geniculati, 2–4 nodosi, ramosi, glabri. *Vaginae* glabrae, carinis costisque glanduloso-punctatis. *Ligula* ciliata. *Lamina* plana, costa media glanduloso-punctata. *Panicula* subdense contracta, ramis solitariis el binis vel ternis e basi ramosis, omnibus glandula subbasali, pedicellis apice glandula annulari. *Spiculae* plumbeae ca 5 mm longae 1–1·5 mm latae, 7–14-florae paleis persistentibus, glumis et lemmatibus post maturitatem deciduis, glumis subaequalibus

quam lemma superius brevioribus, lemmatibus depresse cymbiformibus late ellipticis ambitu oblongis scabridis ad nervos cum glandulis paucibus demersis, paleis quam lemmata brevioribus. *Stamina* 3, antheris globosis 0·3 mm longis. *Caryopsis* late oblongo-elliptica, subtranslucens.

South West Africa.—Luederitz: Farm Klein-Aus, decumbent annual around farm houses, 12/5/49, *Kinges* 2236 (holotype, PRE; isotypes, K, M, BM, Windhoek); 8 m. W. of Aus on rd. to Luederitz, *de Winter* and *Giess* 6083.

Decumbent or semi-erect *annual*, only a few cm high. *Culms* geniculate, 2–4-noded, freely branched, internodes often exposed, semi-terete to flattened, distinctly grooved, glabrous, with an annular glandular ring just below the node. *Sheaths* chartaceous, lax and slipping from the culms, glabrous, ribbed, dotted with sunken glands on the ribs and keel, margins subhyaline, membranous. Ligule a fringe of short stiff hairs. *Collar* glabrous, auricles bearded with long stiff hyaline hairs. *Leafblade* up to 2 cm long and 3·0 wide, soft, more or less flat, subglabrous, dotted with sunken glands on the midrib, secondary veins and margin. *Panicle* fairly densely contracted, rigid, erect, 4–5 cm long and 2–2·5 cm wide, branches single or 2–3 together, divided from the base, branchlets and peduncles short, all divisions with a gland below each branching point, and an annular gland on each pedicel. *Spikelets* leadgrey, about 5·0 mm long and 1–1·5 mm broad, narrowly lanceolate-cultrate in shape, 7–14-flowered, breaking up from below upwards, paleas persistent, lemmas and glumes falling after maturity. *Glumes* subequal, shorter than the subtended lemma, one-nerved, boat-shaped; lower about three-quarters the length of the upper, lanceolate and acute in profile, keel scabrid occasionally with one or two glands; upper obliquely ovate in profile, keel scabrid. *Lemmas* shallowly boatshaped, broadly elliptic-oblong in dorsal view, 3-nerved, scabrid and with a few sunken glands on the nerves. *Pales* about three-quarters the length of the lemmas, strongly bikeeled, scabrid on the keels, persistent. *Lodicules* truncate, cuneate, 0·2 mm long, fleshy. *Stamens* 3, anthers subglobose, small, 0·3 mm long, yellow. *Ovary* glabrous, styles distinct, stigmas plumose. *Caryopsis* semi-translucent, finely striate, broadly oblong-elliptic in ventral view. *Embryo* half the length of the grain. *Hilum* punctiform, basal.

This species prefers disturbed soil and is usually found on roadsides or around farm houses where it grows as a weed. Like other annual semi-desert species it shoots up after rain, flowers and fruits within a few weeks and dies. It is quite an amazing sight to see these little plants hanging by thin taproots from the side of a bone dry sandbank and still being fresh and green.

This small annual is closely related to *E. procumbens*, which likewise occurs in the dry areas of the Free State, Cape and South West Africa. It differs from the latter as set out in the description and is a smaller plant with less dense inflorescences. *E. procumbens* has as yet not been recorded from the coastal Namib and the areas of distribution therefore do not overlap.

Eragrostis lamprospicula *de Winter*, sp. nov., *E. membranaceae* Hack. affinis, sed perenni, cetera spiculis minoribus, inflorescentia minus ramosa ab ea distinguenda.

Perennis, erecta. *Culmi* simplices 2–5-nodosi, ad 65 cm alti, infra nodos annulo glanduloso, nodis glabris. *Vaginae* glabrae carinatae, glanduloso-punctatae. *Ligula* breve ciliata. *Laminae* lineares 5–10 cm longae. *Panicula* laxa, sparse ramosa, ad 12 cm longa 6 cm lata, ramis gracilibus flexuosis, pedicellis 5–12 mm longis apice glandula annulari, spiculis ovato-ellipticis ad anguste oblongis 6–15 mm longis, 6–25-floris, glumis subcoriaceis inaequalibus, uninervatis, lemmatibus coriaceis levibus nitidis latissime ovatis acutis 2–2·5 mm longis 1·75–2 mm latis nervis 3 inconspicuis, palea elliptica 2 mm longa bicarinata truncata membranacea, lodiculis 2 carnosis cuneiformibus 2–3-nervatis, staminibus 3, antheris anguste oblongis 1 mm longis, ovario oblongo stylis 2. *Caryopsis* lateraliter compressa, 1·5 mm longa opaca; embryo dimidio quam granum longiore.

FIG. 2.—*Eragrostis omahekensis* de Winter; a, habit × 1; b, spikelet × 10.

Transvaal.—Waterberg: Mosdene Farm near Naboomspruit; bare brack flats, occasional, 65 cm high, *de Winter* 734 (PRE, holo, K, BM, B, M, BOL, SARH, NY, iso.).

Southern Rhodesia.—Salisbury: Mrs. *Kimpton* s.n.

Erect and usually somewhat geniculate *perennial*. *Culms* simple, flattened towards the base, up to 65 cm high, glabrous, 2–5 usually 3-noded; internodes gradually decreasing in length downwards, exserted from the sheaths, with a ring of glands below the nodes; nodes glabrous usually purplish. *Leafsheaths* striate, glabrous, lower ones often tinged with purple, compressed and keeled, usually dotted with glands on the midrib below the collar and above the nodes, glabrous, bearded at the mouth, outer margin hairy with bulbous-based hairs. *Ligule* shortly ciliate. *Collar* inconspicuous, sometimes purplish, glabrous. *Leafblade* linear, up to 10 cm long, smooth and glabrous on lower surface, grooved and scaberulous on the nerves on upper surface. *Inflorescence* rather lax, sparsely branched, elliptic to ovate in outline, up to 12 cm long and 6 cm wide; basal branches subtended by a glandular patch, 2–4 together but not in a true whorl, paired and opposite or single upwards, fine and flexuous, purplish, bearing the spikelets on long fine alternating pedicels; pedicels 5–12 mm long with an annular often conspicuous gland below each spikelet. *Spikelets* ovate-elliptic to narrowly oblong, 6–15 mm long 6–25-flowered, pallid to gunmetal grey in colour. *Glumes* subcoriaceous, unequal, one-nerved; lower lanceolate, more or less 2 mm long, upper ovate-lanceolate, about 2·5 mm long. *Lemmas* coriaceous, shiny, broadly boatshaped, very broadly ovate in outline, acute, 2–2·5 mm long and 1·75–2 mm wide, 3-nerved, nerves inconspicuous. *Palea* elliptic in outline, 2 mm long, 2-keeled, membranous, margins inflexed, apex truncate. *Lodicules* 2, fleshy, truncate-cuneate, 2–3-nerved. *Stamens* 3; anthers narrowly oblong, about 1 mm long, yellow or purplish. *Ovary* shortly stalked, oblong; styles 2, distinct; stigmas plumose. *Caryopsis* somewhat laterally compressed, 1·5 mm long, obliquely ovate in profile; pericarp swelling and becoming mucilaginous when placed in water; endosperm whitish, quite opaque; embryo half the length of the grain, greenish.

E. lamprospicula is only known from two collections, one from Salisbury in Southern Rhodesia and the other from the Waterberg district of the Northern Transvaal. In spite of our scant records it is doubtful whether the species is rare. It is more likely that it has been overlooked due to its superficial similarity to *E. racemosa*.

The specific name is derived from lampro = shiny and spicula = spikelet an illusion to the glossy spikelets of the species.

Eragrostis omahekensis *de Winter*, sp. nov., affinis *E. horizontali* Peter, sed paniculis multo contractis lemmatibus longioribus et acutioribus glumis chartaceis olivaceis differt.

Herba annua caespitosa, culmis erectis vel ascendentibus. *Vagina* glabra vel sparse villosa, glandulosa vel eglandulosa. *Ligula* fimbriata. *Folia* plana, apice setacea. *Panicula* contracta, ramis glandula subbasali, brevibus, spiculis ramis appressis. *Spiculae* angustae oblongae, 5–7 mm longae 1·5 mm latae, 4–9-florae, lemmatibus et glumis deciduis. *Glumae* subequales, 1·5–2 mm longae. *Lemmata* chartacea, oblique lanceolata carinata, acuta, nervis lateralibus prominentibus. Stamina 3, antheris oblongis 5 mm longis. *Caryopsis* obovato-oblonga subtranslucens levis.

South West Africa.—Gobabis: 12·7 m. W. of Gobabis; *de Winter* 2498 (holotype, PRE, isotype, K, M, BM, Windhoek); 25 m. W. of Gobabis, *de Winter* 2498; near Steinhausen Police Station, *de Winter* 2435; Okasondana, *Schwerdtfeger* 4136; do *Liebenberg* 4560, 4663; Babibabi, *Liebenberg* 4663. Okahandja: *Bradfield* 387; Teufelsbach, *de Winter* 2695; Oukongo, *Dinter* 3364. Otjiwarongo: Quickborn, *Bradfield* 425 and 365.

Erect caespitose annual. *Culms* straight or somewhat geniculate at the base, single or branched, hollow, 2–4 noded, ultimate internode long exserted. *Leafsheaths* lax, mostly shorter than the nodes, keeled, finely to strongly ribbed, glabrous or sparsely

hairy with bulbous-based long hairs, glanddotted on the keel and ribs with a short transverse fringe of stiff hyaline hairs below the auricles. *Ligule* a dense fringe of short hairs. *Leafblade* usually flat, somewhat flaccid, linear, up to 15 cm long and 0·5 mm broad, tapering to a fine point, glabrous or hairy with long bulbous-based hairs; veins slightly raised below, upper surface striate, scaberulous. *Panicle* usually contracted, very narrowly oblong to narrowly oblong-elliptic, 6–20 cm long 2–5 cm wide; branches short with spikelets densely clustered on them, ascending or more or less appressed to the rhachis; rhachis angular or nearly smooth, branches each with a gland at the base. *Spikelets* very narrowly oblong 5–7 mm long and 1·5 mm broad, dark-grey, 4–9-flowered, rhachilla not disarticulating, lemmas caducous after fruiting, paleas and glumes persistent on the rhachis. *Florets* hermaphrodite. *Glumes* subequal, one-nerved, lanceolate, scaberulous on the keels, 1·5–2 mm long. *Lemmas* chartaceous, obliquely lanceolate in profile, keeled, acute, 3-nerved, nerves prominent. *Lodicules* fleshy, cuneate, truncate, about 0·3 mm long. *Stamens* 3. *Anthers* 0·5 mm long, yellow. *Ovary* glabrous, styles distinct, stigma plumose. *Caryopsis* obovate-oblong, semi-transparent when mature, smooth; embryo 2/5 the length of the grain; hilum basal, punctiform.

This annual grass is almost exclusively found on disturbed places especially along roadsides. On old lands it often forms extensive, practically pure stands. Where present in large quantities it should make an excellent hay.

E. omahekensis can fairly easily be confused with *E. horizontalis* but the much more contracted inflorescence, the longer and more pointed lemmas, as well as the firmer grey-green glumes makes it fairly easy to distinguish.

The specific name is derived from the Heroro word " Omaheke " a term used to describe the sandy tree savanah of north-east South West Africa. Up to the present the species has not been recorded outside of this region.

Eragrostis × pseud-obtusa *de Winter*, sp. nov. (*E. obtusa* Munro × *E. echinochloidea* Stapf.)

Planta perennis, caespitosa. *Culmi* 2–3-nodosi, 20–60 cm alti. *Vaginae* striatae, carinatae, carinis saepae glanduloso-punctatis. *Ligula* dense et breviter fimbriata. *Lamina* 5–14 cm longa, 2–3 mm lata, anguste spicata. *Paniculum* plerumque ovato-oblongum, ramis solitariis, angulis glanduloso-punctatis. *Pedicelli* spicularum orbi glanduloso. *Spiculae* late ovato-oblongae, 3–5 mm longae, 2·5–3·5 mm latae, 8–20-florae, olivaceae, lateraliter compressae, rhachilla disarticulata. *Glumae* subaequales, inferiores 1-nervatae superiores 3-nervatae, carinis glanduloso-punctatis. *Lemmata* late et profunde cymbiformia, prominenter 3-nervata. *Palea* 2-carinata, carinis sub media parte anguste alatis. *Stamina* 3, antheris anguste oblongis 0·7–0·8 longis. *Caryopsis* elliptica, 1 mm longa, bis vel ter quam embryo longior, hilo basali punctiformi.

Cape.—Hopetown: Liebenberg 4150. Kimberley: Moran s.n. (Bolus H. No. 13905); Kameelhoek, Bruckner 21; Kenilworth, Levy s.n. (Galpin Herb. No. 6324); Swan s.n.; Wilman s.n. (N.H. No. 28349). Barkly West: Newlands, Wilman s.n. (Bolus H. No. 25457); Wilman s.n. (N.H. No. 28336); Acocks 140; Brueckner 823. Vryburg: Tiger Kloof, Brueckner 320 (PRE, holo); Armoedsvlakte, Mogg 3960; Mogg 3668; Stent s.n. (H. 21516); Benauwdheidsfontein, Marloth 863.

Orange Free State.—Fauresmith: C. A. Smith 3879. Kroonstad: Bothaville, Schweickerdt 1113. Jacobsdal: Schweickerdt 1149.

Transvaal.—Christiana: Burtt Davy 11411. Bloemhof: Lombard Nature Reserve, Leistner 91. Wolmaransstad: Sutton 68.

Cultivated specimens.—Prinshof Experimental Station: Story 1940; de Winter 710. Johannesburg: ex Prinshof Experimental Station, R. de V. Pienaar s.n. (sp. 16 plant 4 and plant 2).

Dense erect caespitose *perennial*, culms straight, or geniculate at the base, mostly simple, occasionally branched, 2–3-noded, 20–60 cm high, nodes mostly exserted from the sheaths. *Sheaths* pallid often hairy on the margins, striate, keeled, finely gland-

dotted on the keel. *Auricles* softly bearded. *Ligule* a dense line of short hairs. *Leaf-blade* rolled or flat, linear, 5–14 cm long and 2·0–3·0 mm broad when flattened, primary nerves raised below, slightly raised above and scaberulous, tapering to a fine point, midnerve often finely gland-dotted below. *Panicle* lax to dense, more or less ovate-oblong in outline, branches divided once or twice, spikelets densely crowded on the branches, divisions angular, densely gland-dotted on the angles, pedicels of spikelets often with a glandular ring. *Spikelets* broadly oblong-ovate, 8–20-flowered; pallid or grey to gunmetal grey, rather plump, laterally compressed, 3–5 mm long and 2·5–3·5 mm broad; rhachilla readily disarticulating above the glumes and between the florets. *Florets* hermaphrodite falling entire. *Glumes* sub-equal boatshaped, keeled dark metallic green, darker in colour than the glumes, obliquely lanceolate in side view, keels distinctly gland-dotted, apex acute to subacute; lower 1–3-nerved; upper 3-nerved. *Lemmas* broadly and deeply boatshaped, chartaceous, broadly elliptic in back view (not flattened), 3-nerved, nerves green, raised. *Palea* elliptic-oblong, slightly shorter than the lemmas, 2-keeled, keels narrowly winged below, shortly ciliate on the keels and less so on the wings, apex emarginate or more or less truncate to rounded, wings and keels firmer in texture. *Lodicules* small, oblong-cuneate, truncate, 0·5 mm long. *Stamens* 3, anthers 0·7–0·8 mm long, cultrate, yellow. *Caryopsis* elliptic, 1 mm long, brown, slightly dorsally flattened; embryo one-third to half the length of the grain; hilum basal, punctiform.

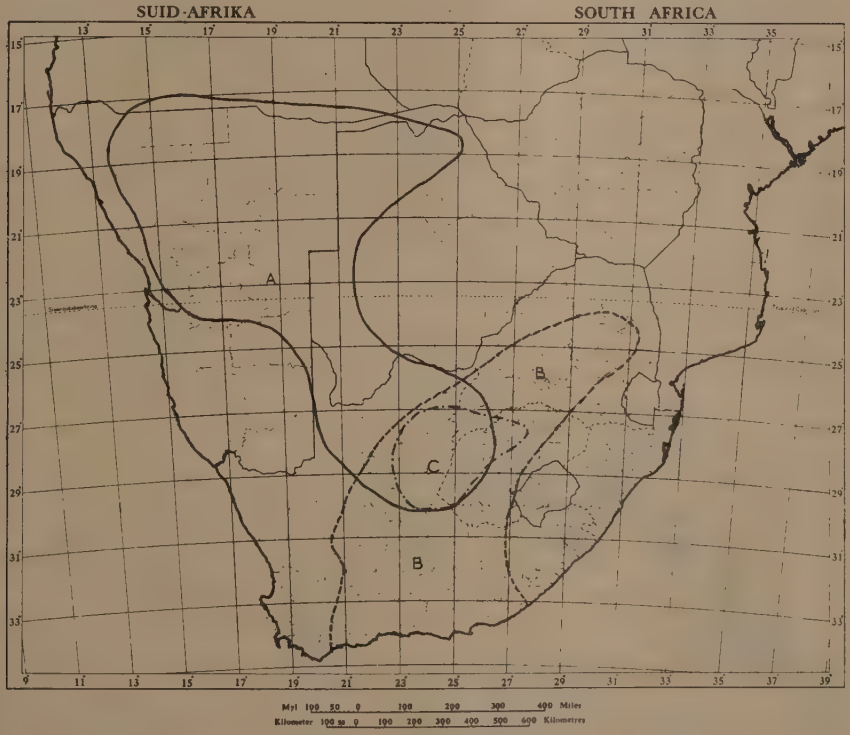

FIG. 3.—Distribution of: A, *Eragrostis echinochloidea*; B, *E. obtusa*; C, *E.* × *pseudobtusa* (*E. echinochloidea* × *E. obtusa*).

FIG. 4.—*Eragrostis pseud-obtusa*; a, habit, × 1; b, spikelet, × 10; c, anther, × 10; d, caryopsis, × 10; e, palea of E. pseud-obtusa, × 10; palea of E. obtusa, × 10; f, palea of E. echinochloidea, × 10.

E. pseud-obtusa occupies an intermediate position between *E. obtusa* and *E. echinochloidea*. The intermediates form a distinct group, situated, when judged on spikelet characters, halfway between the two species. No evidence could be found that these three species naturally grade into one another, in spite of the fact that a large number of specimens of each was available for study. From the rather limited distribution which almost completely covers the area where *E. obtusa* and *E. echinochloidea* overlap (fig. 3), as well as from the completely intermediate character of the spikelet (fig. 4) one can only conclude that the origin of *E. pseud-obtusa* must have been that of a hybrid between the former two species. There is no evidence however that introgressive hibridization has taken place. What the mechanism genetically separating *E. pseud-obtusa* from its parents is, is not clear. It probably is not stabilisation due to doubling of chromosomes, since *E. echinochloidea* and *E. pseud-obtusa* (as sp. aff. obtusa) are both reported to have 2n = 40 by R. d. V. Pienaar in Grasses and Pastures of South Africa 561 (1955). The genome of *E. obtusa* is still unknown.

The great majority of specimens of *E. pseud-obtusa* have in the past, been referred to *E. obtusa*. This is no doubt due to the fact that *E. pseud-obtusa* more strongly resembles *E. obtusa* in the external appearance of the inflorescence and the spikelets than it does *E. echinochloidea*. When the spikelet is examined the winged palea is immediately evident so that the specimens can easily be distinguished from *E. obtusa*. Due to the very strongly congested branches of the inflorescence, as well as the acuminate glumes of *E. echinochloidea*, *E. pseud-obtusa* cannot easily be confused with it (fig. 4).

The following key will facilitate the identification of the species.

Pales shortly ciliate on the symmetrically rounded keels..... E. obtusa.
Pales with a small flap or wing in the lower half of the keels, upper part of keels scaberulous or shortly ciliate.

Branches of the inflorescence secund, very densely contracted with the spikelets densely clustered; glumes distinctly acuminate with the apices diverging and not appressed to the spikelet; flap or wing in the lower half of the keels of the palea usually with a short tooth on the upper part; upper part of keels scaberulous.... E. echinochloidea.

Branches of the inflorescence more or less secund, fairly strongly contracted or somewhat lax with the spikelets laxly to fairly densely clustered; glumes acute to subacute mostly appressed to the spikelet, flap or wing on the lower half of the keels of the palea without a tooth on the upper part; upper part of keels very shortly ciliate. E. pseud-obtusa.

Eragrostis remotiflora *de Winter*, sp. nov., aff. *E. micranthae*, sed ab ea lemmatibus brevioribus haud imbricatis, antheris late ovato-oblongis, caryopsis oblonga dorse canaliculata praecipue differt.

Annua vel *subperennis* 10–55 cm alta. *Panicula* plerumque basi vaginata, demum exserta, 5–20 cm longa 3–14 cm lata ambitu late ovata, laxa, ramis patentibus inferioribus subverticillatis, superioribus solitariis vel binis, rhachide et ramibus primariis saepe glanduloso-punctatis. *Spiculae* solitariae ca 5 mm longae 1 mm latae cinereo-virides vel plumbeae, 4–8-florae, lemmatibus haud vel pauce imbricatis, glumis valde inaequalibus, 1-nervatis, lemmatibus late ovato-oblongis. *Stamina* 3; antherae 0·3–0·4 mm longae. *Caryopsis* oblonga dorsaliter canaliculata.

Transvaal.—Pretoria: in depressis humidis prope Apiesrivier, Jan., 1894, *Schlechter* 4164 (K); Kaalfontein, *Mogg* 3741. Bloemhof: Christiana, *Burtt Davy* 12803 and 12795.

Orange Free State.—Boshoff: 16 m. W.S.W. of Dealesville, *Acocks* 14016. Fauresmith: *Pole Evans* 1583. Bethulie: 7½ m. N.W. of, *Acocks* 13521 (PRE, holo. K, M, B, BM, BOL, iso). Bloemfontein: *Potts* 2423, 2522.

Cape.—Cradock: 12½ m. N.N.W. of, *Acocks* 15764. Tarka: N.N.E. of Tarkastad, *Acocks* 17953. Middelburg: *Acocks* 15807. Barkly West: Danielskuil, *Esterhuizen* 2019 and 1061; Danielskuil *E. Ferrar* 62. Vryburg: Dry Hartz, *Mogg* 8500; Progress, *Mogg* 9007; Armoedsvlakte, *Mogg* 3960.

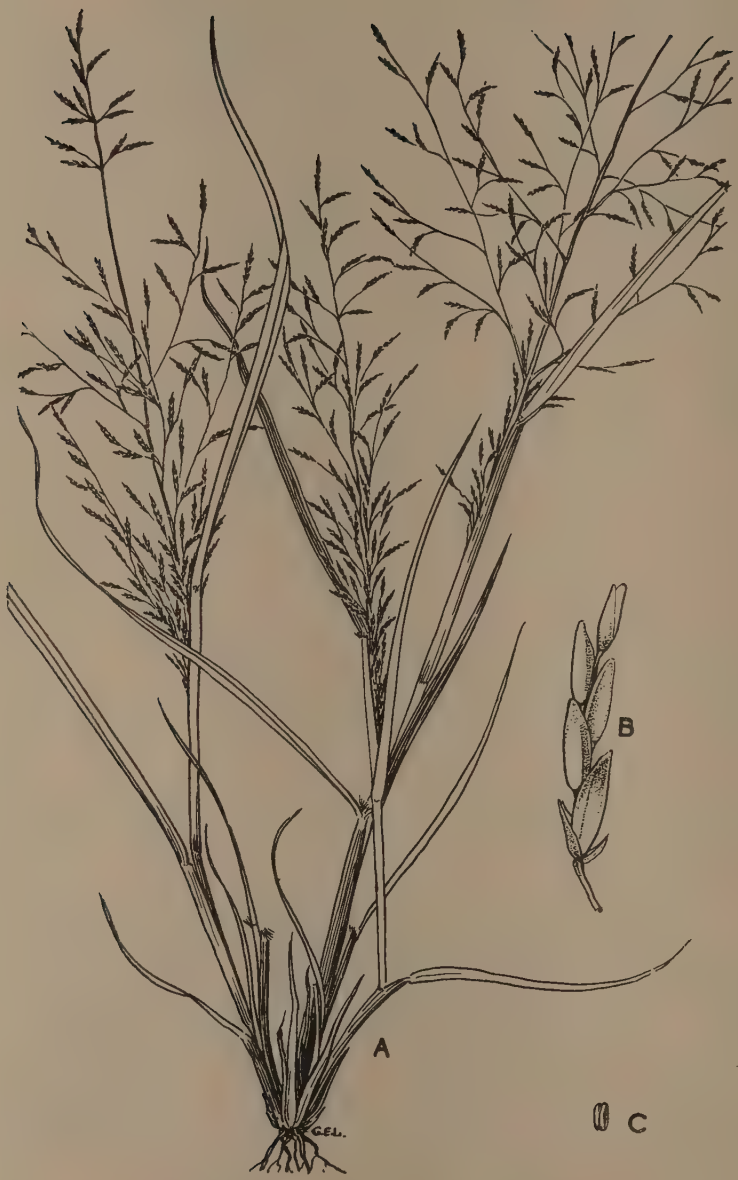

FIG. 5.—*Eragrostis remotiflora*; a, habit, × 1; b, spikelet, × 10; c, anther, × 30; (Acocks 13521).

Annual or *subperennial*, glabrous, 10–55 cm high, culms erect or sprawling and geniculate, 1–4-noded, slender, rather soft. *Sheaths* pallid, pinkish or purplish, weakly striate, usually exceeding the internodes but lax and stripping from the culms, occasionally shorter, chartaceous especially when withered, keeled, glandular on the keels, margins membranous. *Ligule* a very short dense hairy rim; auricles bearded. *Leafblade* linear, glabrous, flaccid, flat or somewhat rolled, up to 17 cm long and 3 mm wide, midrib prominent below, often dotted with glands, primary nerves prominent below, smooth, upper surface finely striate, scaberulous on the striate, blade tapering to a fine point. *Panicle* usually sheathed at the base by the uppermost sheath, finally exserted, as long as or longer than the rest of the plant, 5 × 3 cm to 20 × 14 cm usually broadly ovate in outline, lax, branches patent or spreading at slightly less than a right angle, subwhorled at the base, single or in two's upwards, axils glabrous or with a few hairs, rhachis and primary branches often dotted with sunken glands especially towards the base of the panicle. *Spikelets* solitary, pedicelled, linear, about 5 mm long and 1 mm wide, greenish-grey to lead-grey, occasionally suffused with purple, 4–8-flowered, lemmas usually not overlapping the florets above on the same side or only shortly overlapping at the base. *Florets* hermaphrodite, lemmas and paleas both falling, but not together leaving the undulating rhachis intact. *Glumes* very unequal, lower one-nerved, lanceolate, 0·5 mm long; upper one-nerved, about 1·5 mm long, lanceolate. *Lemmas* broadly ovate-oblong, sub-membranous, 3-nerved. *Pales* equal to or slightly shorter than the lemma, bifid at the apex. *Lodicules* truncate-cuneate. *Stamens* 3; anthers purple, broadly-oblong, 0·3–0·4 mm long. *Ovary* glabrous, styles free; stigmas plumose. *Caryopsis* oblong, brown, finely longitudinally striate, slightly grooved on the back; embryo two-thirds the length of the grain; hilum punctiform, basal.

E. remotiflora resembles *E. pilosa* but can be distinguished from this species by the shorter broader lemmas which do not overlap the base of the lemma directly above it. The lemmas of *E. pilosa* are lanceolate in profile, acute and overlap the base of the lemmas directly above. The grains of *E. remotiflora* are grooved on the back and the embryo is about two-thirds the length of the grain while those of *E. pilosa* taper towards the apex, are rounded on the back and the embryo is about half the length of the grain.

This species is often found growing in association with *E. homomalla* Nees = (*E hygrophila.* Hubb. and Schweick.) and like the latter is a hygophilous grass growing in wet or damp soil on the edge of pans and vleis, in tne semi-arid areas of the Cape, Transvaal and Orange Free State. It shows a superficial resemblance with *E. homomalla* but can easily be distinguished by the laxer panicle and the smooth nerves of the lemmas which are prominent and gland dotted in the latter.

Its closest relative probably is *E. micrantha* which differs by longer lemmas which overlap each other, the larger cultrate anthers and the long narrow grain. The inflorescence moreover, although lax is much more branched and not nearly as scanty as in *E. remotiflora.*

Kaokochloa *de Winter*, genus nov., *Schmidtiae* aff. sed lemmatibus 2–3-aristatis, duobus nervium lemmatis lateralium (interdum necnon nervo mediano) in aristam planam rectam excurrentibus, apice lemmatis inflexo inter aristas in lobos 2 breves latos nigros membranaceos producto praecipue differt.

Annua. Culmi erecti geniculati vel prostrati, ad nodos radicantes. *Vaginae* internodiis breviores. *Ligula* longe ciliata. *Laminae* planae. *Panicula* satis densa, ramis solitariis villosis breve glanduloso-pubescentibus, spiculis 3–6-floris. *Glumae* 9–11-nervatae subaequales late ellipticae velova to-ellipticae. *Flores* hermaphroditi, lemmatibus 9-nervatis late cymbiformis in parte inferiore inter nervos pubescentibus apice inflexo saepe nigro, nervis lateralibus duobus, interdum necnon nervo mediano, in aristam planam rectam excurrentibus, paleis ambitu ellipticis marginibus inflexis carinis fimbriatis. *Lodiculae* 2 cuneatae apice truncatae. *Stamina* 3, antheris linearioblongis flavis. *Ovarium* glabrum, stylis 2 liberis, stigmatibus plumosis. *Caryopsis*

obovata, basibus stylorum asymmetrice insertis coronata; embryo 4/5 longitudinis caryoptidis attingens; hilum basale, punctiforme. Species unica: *Kaokochloa nigrirostris* de Winter, spec. nov.

Kaokochloa has up to the present only been found in the Northern Kaokoveld, where it inhabits the more western dryer parts of the territory. It often forms large dense stands. The grazing value is unknown but probably is fairly high since the grass is a soft annual.

Kaokochloa nigrirostis de Winter, sp. nov.

Annual, 20–60 cm high. *Culms* erect, geniculate or prostrate at the base, and rooting at the nodes, nodes 3–7. *Sheaths* shorter than the internodes, striate, villous with gland-tipped hairs. *Ligule* a fringe of long stiff hyaline bristles. *Auricles* villous. *Leafblade* linear to linear-lanceolate, 5–12 cm long and 5–10 mm wide, tapering to a fine tip, flat, pilose with long slender hairs mixed with shorter gland-tipped hairs. *Panicle* rather dense and contracted, branches single, rhachis and branches grooved, densely villous with a mixture of long villous hairs and shorter gland-tipped hairs. *Spikelets* shortly pedicelled or subsessile and clustered on the rather short branches, sub-globose, about 6 mm wide and 7 mm long, with 3–6 florets. *Florets* hermaphrodite. *Glumes* 9–11-nerved, subequal, equalling the spikelet, broadly boatshaped, 6–7 mm long, broadly elliptic or ovate-elliptic, subacute, villous with long thin hairs mixed with shorter pinshaped glandular hairs. *Lemmas* elliptic in outline, broadly boatshaped, 5 mm long and 3 mm wide, coriaceous, densely hairy in the lower half between the nerves, 9-nerved, one lateral nerve on each side and occasionally the central nerve excurrent in a broad flat straight scabrid awn; lateral awns 4–6 mm long; central awn usually much shorter, 1–3 mm long or not developed; awns usually much shorter or absent in the immature and apical florets; apex of the lemma glabrous, incurved, ending in an awn flanked by two broad short membranous lobes or awn absent and ending in two lobes, lobes usually black in colour. *Palea* elliptic in shape, about 5 mm long and 2 mm wide, thinly coriaceous shallowly concave on the back, keels somewhat thickened, densely fimbriate with short stiff bristles, margins membranous, inflexed, long villous at the base. *Lodicules* 2, somewhat fleshy, wedge-shaped with a more or less truncate apex. *Stamens* 3, anthers linear-oblong, 3–4 mm long, yellow. *Ovary* glabrous, obovate-cuneate in outline, styles 2, stigmas plumose. *Grain* obovate in outline, crowned by the asymmetrically attached base of the style, somewhat convex dorsally and usually flat on the other side; embryo four-fifths the length of the grain, obovate in outline; hilum basal, punctiform, brownish to black.

South West Africa.—Kaokoveld: 18·5 miles West of Otju (Otjihu), mica schist hillocks and mountain slopes with coarse quartz and limestone gravel, de Winter and Leistner 5679 (PRE, holo; K, BM, M, B, BOL, Windhoek); do. 5679a, cult. at Division of Botany from seed of 5679 (K, BM, M, B, BOL, Windhoek, NY); Warmbad (Warmquelle) near Sesfontein, dolomite slope with quartz intrusions, erect annual forming large almost pure stands, de Winter and Leistner 5848 (K, BM, M, Bolus, NY).

The specific epithet is an allusion to the characteristic black apices of the lemmas.

B. de Winter

HYPOXIDACEAE

Rhodohypoxis palustris *Killick*, sp. nov. *R. baurii* (Bak.) Nel affinis, sed ita differt: folia conduplicata semi-carnosa rigidula marginibus exceptis glabra flores semper purpureo-rubicundi.

Cormus globosus 5–7 mm diam. tunicis apice copiose setosis. *Folia* erecto-arcuata anguste linearia acuminata 2·5–10 cm longa 2–3 mm lata conduplicata semi-carnosa nonnihil rigida flavo-viridia marginibus pilis longis albis alioqui glabra. *Pedicelli* 1–2

simplices erecti graciles 1–6 cm longi sericei. *Perianthium* purpureo-rubicundum tubo 5 mm longo sericeo segmentis oblongis 7–11 mm longis. *Stamina* 6 antheris 2 mm longis. *Ovarium* turbinatum 3 mm longum stigmate trilobato.

Cape Province.—Maclear District: seepage on upper eastern slopes of Drakensberg, locally frequent, 8,000 feet, Naude's Nek Pass, *Acocks* 12183; boggy slopes, Naude's Nek, 20·5 miles N.E. of Rhodes, *Marais* 1372.

Natal.—Bergville District: locally abundant among small stones in shallow stream, 6,050 feet, Cathedral Peak Forest Influences Research Station, *Killick* 956; locally common among small stones in stream in Catchment 1, 6,015 feet, Cathedral Peak Forest Influences Research Station, *Killick* 1602 (PRE, type). Estcourt District: Giants Castle, 8,000 feet, *Symons* 156. Impendhle District: locally abundant in vlei with roots in water, 6,000 feet, " Tillietudlam ", *Huntley* 460.

A perennial herb with a globose corm 5–7 mm diam. with fleshy roots and crowned with persistent bristles. *Leaves* radical, erecto-arcuate, narrowly linear, 2·5–10 cm long, 2–3 mm wide, sheathing at base, conduplicate, semi-succulent, somewhat rigid, margins with long white hairs, otherwise glabrous, yellowish green. *Pedicels* 1–2, simple, erect, 1–6 cm long, sericeous. *Perianth* purplish-pink, tube 5 cm long, sericeous; segments oblong, 7–11 mm long, 3–4 mm wide. *Stamens* 6, arranged in two series; anthers 2 mm long. *Ovary* turbinate, 3 mm long; stigma minute, trilobed.

This small plant from the Drakensberg Mountains is an attractive addition to *Rhodohypoxis*, a genus of only two species. For nearly fifty years this plant has passed as *R. baurii* (Bak.) Nel, but it can be distinguished on the following grounds:—

A.—The leaves are conduplicate, semi-succulent, yellowish-green, rather rigid and only hairy on the margins, whereas in *R. baurii* they are more or less flat with a median groove, coriaceous, greyish-green and hairy all over. The leaves of *R. palustris* are narrower than those of typical *R. baurii*, but about equal to those of *R. baurii* var. *milloides*. B.—The flowers are purple-pink, red or crimson. In *R. baurii* they vary from white in forma *platypetala* to red in the typical form. C.—*R. palustris*, as its name indicates, is a vlei or marsh plant, whereas *R. baurii* occupies comparatively dry habitats, for example mountain grassveld and rock outcrops.

D. J. B. Killick

LILIACEAE

Allium rotundum *L.* Sp. Pl. ed. 2: 423 (1762).
A. ampeloprasum var. B. Gawler in Curt. Bot. Mag. t. 1560 (1813); Thunb. Prod. 65 (1794). *A. dregeanum* Kunth, Enum. 4: 382 (1843); Fl. Cap. 6: 407 (1897). Type: Cape, Queenstown, Stormberg Range *Drège* 8660a (K?).

In the Flora Capensis Baker accepted Kunth's species, *A. dregeanum*, as the only indigenous species found in South Africa. He rejected Regel's conclusion that it should be sunk under an old well-known European species, *A. scorodoprasum* L. (cf. Monogr. All. 42 1875). Recently material of this species was sent to Munich where it was identified as *A. rotundum* L. a native of central and southern Europe and the near East.

Ornithogalum seineri (*Engl. and Krause*) *Oberm.* comb. nov. *Bulbine seineri* Engl. and Krause in Engl. Bot. Jahrb. 45: 124 (1910). Type: Bechuanaland, Litauani, on grey sand rich in humus between limestone, *Seiner* II, 98 (B, holo.! PRE, photo).
Anthericum seineri (Engl. and Krause) Poelln. in Fedde, Rep. 53: 136 (1944).

Ornithogalum filibracteatum Oberm. in Ann. Transv. Mus. 17: 194 (1937). Type: Transvaal, Letaba: Mbayinbayi, 28 m. south-west of Punda Maria, *Lang* TM 31099 (PRE, holo!). *O. wilmaniae* Leight. in Journ. S.A. Bot. 11: 168 (1945). Type: South West Africa, Gobabis district, Sandfontein, *Wilman* in BOL 15280 (holo) in KMG 1599 (iso).

Urginea langii Brem. in Ann. Transv. Mus. 15: 237 (1933). Type: Transvaal, Pietersburg: Brak Rivier vlei, *Bremekamp* and *Schweickerdt* 25 (PRE, holo!).

This *Ornithogalum*, like many others, may look deceptively different in the herbarium because of several factors. In a wet season the uppermost flowers develop, giving the raceme a cylindrical appearance but in dry conditions these remain sterile thus giving it the pyramidal shape so typical of *Urginea langii*. The type of *O. filibracteatum* shows a very young inflorescence with short pedicels and long filiform bracts protruding far beyond the buds. As the pedicels lengthen only during anthesis none had attained their maximum length when the specimen was preserved. The long filiform bracts giving the young raceme a brushlike appearance, seem characteristic but it was seen in other species, for instance *O. pulchrum* Schinz, that they may be long or short in specimens found in the same area; moreover the thin upper part of the bract often dries up at an early stage.

Bremekamp had classified this species as an *Urginea* because of the flat round seeds. The seed of *Urginea* however is very different; it is long, narrow-elliptic, with a narrow, often winged membrane around its perimeter. There are moreover some other very good characters which typify the genus *Urginea* and which are absent in our species; (*a*) the inflorescence and the often hysteranthous leaves evolve from different buds whilst in *Ornithogalum* the central raceme terminates the leafy rosette; (*b*) the lowest or central bracts are spurred; (*c*) the bulb consists of loose scales. Dr. J. M. J. de Wet who studied the chromosome pattern of *Ornithogalum wilmaniae* Leight. (cf. Cytologia 22: 145–159, 1957) found that it possessed large chromosomes with the number n = 10 and they showed affinity to other South African species of *Ornithogalum*. Dr. de Wet suggested that it might form a stepping stone between *Urginea* and *Ornithogalum*.

The type of *Bulbine seineri* Engl. and Krause has no underground parts preserved but Seiner described it as a bulbous plant. The filaments are described as " tenua ", and are not bearded.

The species is found in the warmer parts of the Kruger National Park, in the Transvaal Bushveld, the Kalahari region and the northern districts of South West Africa.

Ornithogalum pulchrum *Schinz*. In her revision of the South African species of *Ornithogalum* [J.S.A. Bot. X: 169 (1944)], Leighton mentions that *O.pulchrum* Schinz [Verh. Bot. Ver. Prov. Brandenb. 31: 221 (1890)] might be the same as *O. wilmaniae* but as she had not seen the type and as it had no leaves, she hesitated to associate her species with *O. pulchrum*. The Director of the Zürich herbarium kindly sent us the Schinz type on loan. *O. pulchrum* is a tall plant, not identical with *O. seineri* (*O. wilmaniae*) and the following specimens at PRE match the type.

South West Africa.—Grootfontein: Tsumeb, *Naegelsbach* 9. Omaruru: Spitzkopje, *Boss* TM 36006. Kaokoveld: Kaoko-Otavi, *de Winter and Leistner* 5573. Okavango Native Territory: near Okavango River at Mupini, *de Winter and Marais* 4497 (with shorter bracts).

Southern Rhodesia.—Sabi–Lundi River Junction, *Wild* 3490.

Baker in the Flora of Tropical Africa 7: 545 (1898) placed *O. pulchrum* under *O. longibracteatum* Jacq. This species comes from the eastern Cape and *O. caudatum* Jacq. is a synonym. The length of the bracts varies and is unimportant.

Some differences between *O. pulchrum*, *O. longibracteatum* and *O. seineri* are as follows

O. pulchrum	*O. seineri*	*O. caudatum*
Tall plants up to 2½ m.	Plants up to 50 cm.	Plants up to 1 m.
Leaves up to 70 cm long.	*Leaves* up to 30 cm long.	*Leaves* up to 70 cm long.
Raceme cylindrical bearing ca 300 flowers; usually with sterile apical flowers.	*Raceme* usually pyramidal bearing ca 100 flowers; usually with sterile apical flowers.	*Raceme* cylindrical bearing ca 80 flowers; no sterile apical flowers seen.
Scape 200 cm high, straight.	*Scape* ca 20 cm high arcuate.	*Scape* ca 80 cm, straight.
Bracts up to 7 cm long (occasionally shorter).	*Bracts* 2 cm long (occasionally longer).	*Bracts* variable in length, 2–4 cm long.
Pedicels slender, up to 2·5 cm in fruit.	*Pedicels* sturdy, up to 6 cm in fruit.	*Pedicels* slender up to 1·2 cm in fruit.
Perianth segments lanceolate, 20 mm long.	*Perianth segments* lanceolate, 17 mm long.	*Perianth segments* ovate, 10 mm long.
Filaments ovate, attenuated to the apex.	*Filaments* linear-lanceolate, acute near the apex.	*Filaments* ovate, attenuated to the apex.
Ovary oblong, 3-lobed.	*Ovary* oblong, 3-lobed.	*Ovary* rounded.
Capsule 3-angled.	*Capsule* 3-angled.	*Capsule* rounded.
Seeds discoid, elliptic, 8 mm long.	*Seeds* discoid, round, 11 mm in diam.	*Seeds* angled, narrow-oblong in outline.
Solitary plants.	Gregarious plants.	Solitary or in clumps, producing bulbils
Sweet smelling.	Faintly scented.	Said to be scentless.
Northern South West Africa, Southern Rhodesia.	Northern Transvaal, Kalahari Region, central and northern South West Africa.	Eastern Cape, Natal.
Usually in rocky crevices.	Sandy flats.	In shady kloofs and grassy valleys.

The type of *Urginea dimorphantha* Bak. [Bull. Herb. Boiss. 2nd Ser. No. 8, p. 663 (1903)] from South West Africa, Ovamboland. Ondonga, *Rautanen* (Z. holo PRE, photo), kindly sent on loan to us by the Director of the Zürich Herbarium, proved to be a synonym of *Ornithogalum pulchrum* Schinz. Baker had placed this specimen under *Urginea* as the seeds are discoid.

A. Amelia Obermeyer

MALVACEAE

Abutilon flanaganii *A. Meeuse*, sp. nov., *A. pseudocleistogamo* Hochr. affinis, sed inter alia floribus majoribus, petiolis longioribus differt.

Frutex ramosus 25–40 cm altus verisimiliter perennis. *Caules* teretes cinereo-velutini. *Folia* late ovato-cordata, interdum indistincte 3-lobata, plus minusve acuminata, obtusa minutissime mucronata, irregulariter crenata vel sinuata vel subserrata interdum subintegra, supra intense viridia minutissime stellato-velutina, subtus cinerea, stellato-velutina, nervis subtus prominentibus; lamina 2–5 cm longa 1·5–4 cm lata, petiolis gracilibus cinereo-velutinis interdum parce pilosis 2–5 cm longis, stipulis subulatis 4–6 mm longis. *Pedicelli* graciles axillares, solitarii, cinereo-velutini, ad 60 m longi apicem versus articulati. *Calyx* cinereo-velutinus, 5-fidus, tubo cupuliformi c. 3 mm longo, lobis lanceolatis vel lanceolato-deltoideis carinatis aristato-apiculatis c. 7 mm longis. *Petala* flava subglabra basi dense ciliata c. 20 mm longa. *Columna staminalis* apice stellato-hirsuta. *Infructescentia* discoidea, 4–5 mm alta, c. 9 mm diam., mericarpiis 9–13 monospermis subquadratis muticis vel minute mucronatis stellato-hirsutulis c. 4 mm longis 5 mm latis. *Semen* minutissime punctato-verruculosum c. 2 × 1·5 mm.

Cape Province.—Komgha: near Komgha, *Flanagan* 340 (PRE, holo.!, NBG, iso.!).

A low much-branched shrub 25–40 cm tall apparently perennial, covered on the vegetative parts, pedicels and calyces with a short smooth velvety tomentum which is canescent except on the upper leaf-surface, in addition longer more or less patent pilose hairs are sometimes found at the very base of the lower leaf-surface, stems, on the petioles and on the pedicels, more often in tufts at the apex of the petiole. *Stems* terete, slender but firm to wiry, glabrescent, the bark ultimately somewhat wrinkled. *Leaves* broadly ovate-cordate, sometimes very faintly 3-lobed, shortly acuminate obtuse and generally minutely mucronate, irregularly crenate, repand or serrate to subentire, 2–5 cm long and 1·5–4 cm broad, dark green (drying dark olive brown) and very shortly velvety above, the paler lower surface with fine prominent main veins; petioles slender, 2–5 cm long; stipules subulate, 4–6 mm long. *Flowers* solitary, axillary; pedicels slender, up to 5 cm long articulated in upper 10 mm. *Calyx* deeply dissected; tube cupuliform, about 3 mm long, lobes lanceolate to triangular-lanceolate, carinate by the prominent midrib, apiculate-aristate, about 7 mm long. *Petals* yellow, glabrous or nearly so except the densely ciliate narrow base. *Staminal column* stellate-hirsute at the apex of the conical dilated basal portion. *Fruit* discoid, 4–5 mm high and about 9 mm in diam., of 9–13 subquadrate 1-seeded, 3–4 mm high and 5 mm broad mericarps which are horizontally truncate at the upper edge forming an acute or somewhat mucronate angle of about 90° with the dorsal side, are rounded at the basal dorsal angle and have a subterminal ventral tooth which is almost level with the apical edge. *Seed* finely punctate-verruculose, about 2 × 1·5 mm.

This species differs from all other African species in the small mericarps which are broader than they are high. The only other species with similar mericarps is *A. pseudocleistogamum*, a Madagascan species from which it differs in several respects, especially in the much larger flowers and considerably longer petioles. In habit it is not unlike *A. fruticosum* and *A. sonneratianum*, but its small 1-seeded mericarps distinguish it at once. *A. flanaganii* is named after Henry G. Flanagan, who contributed so much to our knowledge of the flora of the Eastern Cape Province, mainly of the Komgha and surrounding districts, through his extensive collections of neatly prepared herbarium specimens of which the main set is in the National Herbarium, Pretoria.

A. flanaganii is apparently a very local and rare species, because only the single cited gathering was found among all the material from the South African and some European herbaria.

A. galpinii *A. Meeuse*, sp. nov., *A. grantii* A. Meeuse (*A. indico* sensu Harv., non Don)* et *A. piloso-cinereo* A. Meeuse (vide infra) arcte affinis, sed mericarpiis minoribus, foliis majoribus caudato-acuminatis praecipue differt.

Suffrutex ramosus c. 75 cm altus, breviter stellato-tomentosus vel subvelutinus in partibus junioribus sparse glandulosus. *Caules* interdum breviter stellato-pilosi. *Folia* late ovato-cordata vel cordato-suborbicularia, 3–16 cm longa 2–12 cm lata, abrupte acuminato-caudata, subtriloba, margine irregulariter dentata, crenata vel subserrata, supra intense viridia in siccitate atrobrunnea dense strigoso-subvelutina demum glabrescentia et scabrida, subtus pallidiora subarachnoideo-tomentosa, petiolis laminis subaequilongis, stipulis lineari-lanceolatis ad 6 mm longis. *Flores* solitarii, axillares, pedicellis gracilibus ad 5 cm sub fructu ad 7 cm longis. *Calyx* cupuliformis, infra medium lobatus, molliter stellato-tomentosus 9–12 mm longis, lobis ovatis vel ovato-deltoideis apiculato-caudatis, apiculo subulati-filiformi ad 2·5 mm longo. *Petala* lutea vel dilute ochracea, glabra, basi ciliata, 11–13 mm longa. *Columna staminalis* basin versus subsparse stellato-hirsutula. *Infructescentia* breviter cylindrato-semiglobosa interdum subcampanulata, apice truncato-concava, c. 10 mm longa 12–14 mm diam. *Mericarpia* c. 16, 3-sperma, oblique truncata, dorso et apicem versus subsparse molliterque stellato-pubescentia 8–10 mm longa 5–6 mm lata, acuta vel mucronata. *Semina* 2·5 × 2 mm, atrobrunnea, minute verrucoso-punctata.

* Vide Meeuse in Fl. Zamb. part 2 (1960), in press.

Transvaal.—Barberton: Barberton, Umvoti Creek, *Galpin* 767 (PRE, holo.!, GRA, iso.!); Valley near Edwin Bray Battery, *Galpin* 1197 (PRE); Barberton without precise locality, *Williams* s.n. = TRV 7671 (PRE).

Swaziland.—Bremersdorp, *P. Hutchinson* 8 (PRE).

Portuguese East Africa.—Lourenco Marques Distr.: Goba, Lebombo escarpment, *Fidalgo de Carvalho* 257 (LM, PRE).

Natal.—Lower Tugela: Tugela Valley below Sans Souci, *Edwards* 1688 (NU, PRE).

Suffrutex attaining a height of at least 75 cm, much branched in upper portion, covered with a short stellate-tomentose to velvety pubescence on vegetative parts, pedicels and calyces; the youngest parts, apical portions of pedicels and calyx-tube sometimes also somewhat glandular. *Stems* slender, wiry, terete, rather soon woody, glabrescent, the pubescence sometimes somewhat pilose. *Leaves* broadly ovate-suborbicular with cordate base and a triangular long-attenuate to acuminate or caudate apex, often abruptly narrowed into the acumen from a broad base which gives the blade a low, but distinct, 3-lobed appearance; the tip of the acumen subobtuse to acute, minutely mucronate; the basal sinus more or less triangular, usually rather deep; basal lobes rounded, the small lateral lobes, if present, more or less triangular, obtuse or acute; the margin irregularly dentate, serrate or crenate, generally shallowly so to subentire but the apical portion of the acumen always entire; upper surface deep green often drying a dark olive-brown, when young densely velvety strigose, later sparsely stellate-strigose, glabrescent and turning slightly scabrid, lower surface distinctly paler, dirty greyish-yellow, sometimes faintly glaucous, at first very densely stellate-tomentose, later with a cob-webby stellate tomentum; petioles terete, in young leaves tomentose, later usually with short spreading to deflexed somewhat stiff stellate hairs especially near the apex, a little shorter to a little longer than the 3–16 cm long and 2–12 cm broad blades; stipules linear-lanceolate, up to 6 mm long. *Flowers* solitary, axillary on main stems and/or on short lateral shoots; pedicels slender, terete, in flower up to about 5 cm, in fruit up to about 7 cm long, articulated near the apex. *Calyx* cupuliform, lobed to a little beyond the middle, 9–12 mm long, with ovate to ovate-triangular acute lobes each terminating in a subulate to filiform, up to 2·5 mm long, apiculus. *Corolla* described as orange-yellow and buff; petals 11–13 mm long, glabrous or nearly so, the narrowed base ciliate. *Staminal column* rather coarsely and sparsely beset with many-rayed stellate-hairs in basal, conical portion. *Fruit* shortly subcylindric to semi-globose or slightly campanulate about 10 mm high, 12–15 mm in diam., truncate-concave at the apex; mericarps about 16, 3-seeded, 8–10 mm long measured along the back and 5–6 mm broad; much compressed, papery, softly and rather sparsely stellate-pubescent along the back and apical portion; the back straight or somewhat bulging in lower half, then inwardly rounded into the truncate base, the apical edge convex or nearly straight, slanting upwards towards the shortly toothed mucronate dorsal apical angle, ventral tooth small. *Seeds* 2·5 × 2 mm, dark brown, finely verruculose-punctate with minute, usually orange-brown protuberances.

The much compressed relatively broad, and papery mericarps indicate that this species is related to *A. grantii* (= *A. indicum* sensu Harv. in Fl. Cap., non Don) and *A. piloso-cinereum*, and consequently to *A. sonneratianum*, but the mericarps are very much smaller, the leaves larger and caudate-acuminate and the calys-lobes have a subulate-filiform up to 2·5 cm long apiculus.

This species remained unrecognised for a long time although it was collected by Galpin as early as 1896. Burtt Davy, in his Manual Fl. Transv. 2: 275 (1932), refers *Galpin* 767 to *A. mauritianum* (Jacq.) Medic. to which it is not remotely related, and *Galpin* 1197 to "*A. indicum*" (= *A. grandiflorum* Don) which it does not resemble.

The species under discussion seems to be mainly restricted to the Barberton area and the Lebombo range. It is found in light shade on lower mountain slopes between 600–1,200 m altitude.

A. piloso-cinereum *A. Meeuse*, spec. nov., *A. grantii* A. Meeuse (= *A. indico* sensu Harv. non Don) arcte affinis, sed plantis canescentibus ceteris caulibus petiolis pedicellisque pilis longis patentibus subsparsis obtectis praecipue differt.

Suffrutex probabiliter annuus pauce ramosus ad 1·50 m altus. *Caules* stellato-tomentosi vel subvelutini, pilis longis patentibus subsparsis pilosi. *Folia* late ovato-cordata vel suborbiculari-cordata ad triangulato-cordata, interdum plus minusve 3-lobata, apice acuminata vel attenuata, margine subregulariter serrata vel crenato-de tata, supra saturate viridia minute adpresse stellato-pubescentia demum glabrescentia, subtus molliter velutinosa albido-canescentia conspicue prominenter venosa, 2–7 cm interdum ad 15 cm longa, 1·3–5 cm interdum ad 10 cm lata, petiolis laminis subaequilongis tomentosis vel subvelutinis pilis patentibus sparse pilosis. *Flores* axillares solitarii, pedicellis tomentosis vel subvelutinis pilis patentibus sparse pilosis. *Calyx* campanulato-cupuliformis, infra medium lobatus, 9–12 mm longus, dense velutinus, lobis ovato-lanceolatis vel oblongo-lanceolatis acutis vel acuminatis vel breviter apiculatis. *Petala* flava 14–18 mm longa, glabra. *Infructiscentia* subcylindrato-semiglobosa, 10–12 mm longa, 15–20 mm diam. *Mericarpia* 10–18, 3-sperma, 10–12 mm longa, 6–7 mm lata, apice oblique subtruncata angulo dorsali dentato vel rostrato, dorso et apicem versus stellato-pubescentia vel tomentosa. *Semina* c. 2 × 2 mm, minute verruculosa.

Transvaal.—Pietersburg: Chunies Poort Police Station, *Meeuse* 10352 (PRE, rolo.!, BM, BOL, EA, K, L, LD, M, SRGH, isos.!). Potgietersrust: near Potgietersrust, *Maguire* 1499 (NBG). Waterberg: farm Mosdene near Naboomspruit, *Galpin* M 23. Brits: Hartebeespoort, *Lotsy and Goddijn* 348 (L); Hekpoort, *J. Phillips* 519. Pretoria: 18 m N.E. of Pretoria near Roodeplaat, *Repton* 4309; about 12 miles from Pretoria on road to Zeekoegat (Roodeplaat), *Repton* 979; Pretoria North, *Crawley* PRE no. 5181; Pretoria, Arcadia, *Leendertz* 463 (L, PRE); Pretoria, Curtis' Hill, *Pole Evans* 75; Pretoria, *Esterhuysen* h. no. 26321 (BOL); Fountains Valley, *Repton* 223; Hennopsrivier, *Bremekamp* TRV no. 29048. Krugersdorp: Waterval Kloof, *Mogg* 20353 (J, PRE). Vereeniging: Kaalplaats, *Mogg* 10222. Klerksdorp: Klerksdorp, " *Convent* " 67 (GRA). Rustenburg. Zwartruggens Ridge, *Sutton* 827, 849; Witkranskloof, *Rose Innes* 41. Marico: Zeerust, *Leendertz* h. no. 11312.

Orange Free State.—Kroonstad: Kroonstad, *Pont* 681; Fauresmith: Fauresmith, *Verdoorn* 946, 1180, *Verdoorn* in herb. Henrici 2396, *Smith* 3980, *Henrici* 2008, *Leistner* 1104 (KMG, PRE). Bloemfontein: Bloemfontein, *Bolus* 11047 (BOL), *Wasserfall* 842 (NBG); Naval Hill, *Potts* 8022; Glen, *Potgieter* 60. District unknown: " Sepani ", *Brierley* 21 (BM).

Cape Province.—Aliwal North: Ruigtefontein, *Theron* A1795 (NH, PRE).

(All specimens, if not otherwise indicated, in PRE).

A low suffrutex or soft shrub usually scantily branched (from the base or only higher up), probably annual, covered on stems, petioles and pedicels with a short dense tomentose or velutinous pubescence which is usually greyish or whitish and interspersed with long thin patent hairs. *Stems* terete, ultimately somewhat woody with a rather large pith and a thin somewhat wrinkled grooved bark. *Leaves* in outline suborbicular cordate or broadly ovate-cordate to triangular-cordate, sometimes faintly 3-lobed by projecting lateral lobules near the middle of the blade, acuminate or gradually attenuate at the apex, rather regularly crenate-dentate to serrate but usually only shallowly so, 2–7 cm, occasionally up to 15 cm long and 1·3–5(–10) cm broad; upper surface dark green, minutely adpressed-stellate pubescent, glabrescent, the lower surface canescent, softly tomentose to velutinous with prominent nervation; petioles about as long as the corresponding blades; stipules subulate, tomentose or velutinous. *Flowers* axillary, solitary; pedicels in flower up to 7 cm long, in fruit up to 9 cm. *Calyx* cupuli-

form-campanulate, densely velutinous and the tube sometimes with additional patent hairs, greyish, grey-green or canescent, deeply lobed, 9–12 mm long; the lobes oblong-lanceolate to lanceolate, acute, shortly acuminate and/or shortly apiculate. *Petals* yellow, 14–18 mm long, glabrous. *Staminal column* stellate-pubescent. *Fruit* semi-globose-subcylindric, 10–12 mm long and 15–20 cm in diam. *Mericarps* 10–18, 3-seeded, 10–12 mm × 6–7 mm, the apical edge somewhat convex, slanting upwards and outwards and meeting the dorsal side at an acute angle, produced into a tooth or subulate up to 2 mm long awn; the ventral tooth small, the keel on the back and the apical edge with a row of many-rayed stellate hairs flanked on either side by a zone which is rather sparsely tomentose or stellate-pubescent with adpressed, smaller and fewer-rayed stellate hairs. *Seeds* about × 2 mm, minutely verruculose-punctate.

This plant is obviously closely related to *A. grantii*, a coastal species, which it resembles very much in the morphology of the mericarps. It differs in a number of points such as in the leaf-shape which is usually abruptly acuminate in *A. grantii* from a broad basal portion and hence more distinctly 3-lobed, in the leaf-margin which is usually more entire in *A. grantii* and in the pubescence of the lower leaf-surface which is very short and smoothly velutinous in *A. grantii*, more loosely stellate-velutinous in *A. piloso-cinereum*, but mainly in the presence of long patent hairs which are never numerous in *A. grantii* (and restricted to the very young parts and the apices of the petioles), conspicuous in *A. piloso-cinereum*, and in the colour of the stems which are not canescent and often dark purple in *A. grantii*, canescent in the other species anb later brownish or greyish but never dark.

A. grantii is a perennial and *A. piloso-cinereum* apparently an annual, but this difference is not always evident from herbarium specimens. *A. piloso-cinereum* is by no means rare; the numerous cited specimens also indicate that it is wide-spread. The specimens were lying in the herbaria usually under *A. sonneratianum* or "*A. indicum*".

It is a plant of rocky slopes in areas with a fairly low annual rainfall, found at altitudes between 900 and 1,200 m and its ecology is, therefore, quite different from that of *A. grantii* which is a plant of coastal bush and lowland forests below 300 m altitude, not usually found on rocky soil but generally on alluvial deposits.

Pavonia transvaalensis (*Ulbr.*) *A. Meeuse*, stat. nov.—*P. schumanniana* Gürke var. *transvaalensis* Ulbr. in Engl. Bot. Jahrb. 57: 178 (1921). Type of variety: Transvaal, Magalakwin River, *Schlechter* 4270 (B, holo.†, PRE, iso.!).

P. schumanniana Gürke var. *parviflora* Schinz in Bull. Herb. Boiss. 2me sér. 3: 829 (1903). Syntypes of variety: Transvaal, Pretoria Distr., *Rehmann* 4185, 4365, 4938; Potgietersrust Distr., *Rehmann* 5492 (all in Z).

P. commutata Conr. in Kew Bull. 1908: 220 (1908); Schinz in Vtljschr. Naturf. Ges. Zürich 68: 428 (1923); Burtt Davy, Man. Flow. Pl. Transv. 2: 278 (1932), non Garcke. Type: Transvaal, Pretoria, *Conrath* 42 (K, holo.!).

The status and synonymy of *Pavonia commutata* Conr. in relation to some other species of *Pavonia*, especially *P. clathrata* Mast. (= *P. schumanniana* Gürke), was cleared up and discussed by Schinz (1923), but this author overlooked the fact that the epithet *commutata* was pre-occupied in *Pavonia*. The epithet selected from the two varietal names cited above is not the oldest, but the epithet "*parviflora*" is inappropriate, whereas "*transvaalensis*" is very suitable for this species which has not been recorded from outside the Transvaal.

A. Meeuse

PLUMBAGINACEAE

Limonium

In Flora Capensis 4, 2: 419 (1906) Wright retained the generic name *Statice* for the species from southern Africa. Sprague in Journ. Bot. 62: 267 (1924) reaffirmed that *Limonium* should be restored to generic status and gave a fairly comprehensive index to relevant literature. The result of the restoration of *Limonium*, excludes *Statice* from the indigenous flora of southern Africa. However, for convenience of discussion, existing names will be used in the following notes.

The distribution of *Limonium* species is generally accepted as being predominantly maritime. It is interesting to note, therefore, that one variable species, *L. dregeanum* (Presl.) O.K., has a wide distribution inland and extends to relatively high atlitudes in the central Karoo. On the other hand no species occurs on our coast further east than about Kentani in the Cape Province.

In working on the genus for the Flora of Southern Africa the usual crop of problems had to be faced and I wish to thank very sincerely the Curators and Directors of the several institutions which supplied material for study. These include K, UPSV, S, SBT, G, M, BOL, GRA, STE, SAM and NBG.

As regards the generic description of *Limonium*, in none of the southern African herbarium material dissected could I distinguish a measurable corolla tube and all petals appeared to be free to the base and to have the filaments of the stamens attached slightly above the base. The anthers of all material dissected were divided up to the point of attachment of the filament and in no case was this appreciably less than half the length of the anther. The ovary was invariably five-angled with five free styles, one from the margin of each angle at the top.

An early problem was the identity of *Statice perigrina* Bergius, Descript. Pl. Cap. 80 (1767), which has priority of publication over all other names, including *S. purpurata* L. in his Mantissa, also published in 1767 (see Sprague in Kew Bull. 1929: 88). Boissier in DC. Prod. 12: 667 (1848) regarded *S. perigrina* Berg. as a synonym of *S. rosea* Smith (1819) and Wright F.C. 1.c. 420, followed suit but they chose to retain the epithet *rosea*. Smith, however, when describing his *S. rosea* place, *S. perigrina* doubtfully under *S. purpurata* L. thus indicating that he excluded it from his *S. rosea*. Photographs and notes from Stockholm prove that *S. perigrina* does not agree specifically with *S. purpurata*. One of the features of *S. purpurata* is the smoothness of the leaves, whereas those of *S. perigrina* are in fact roughish on both surfaces, although Bergius described them as glabrous on the upper surface and scabrid on the lower. My research supports the taxonomy of Boissier and Wright but the epithet *perigrina* must be restored to priority.

The position is complicated further by the presence in Malmesbury district, with the above-mentioned species, of *S. longifolia* Thunb. (1794), which was regarded by Boissier (1848) as a variety of *S. purpurata* L. Unlike the others, *S. longifolia* is constant in having dense adpressed hairs almost to the tips of the calyx ribs. A specimen, *Compton* 19361, from Bellville Division, nearest *S. purpurata* L. has a few hairs near the tips of the calyx ribs and another, *Acocks* 19785, from Clanwilliam, regarded by me as a form of *S. perigrina* also has a few hairs towards the tips of the calyx ribs. In this feature they indicate some relationship with *S. longifolia*, which has a wide range of distribution along the Cape western districts.

With *S. longifolia* Thunb. in the picture, it seems that *S. purpurata* falls somewhere between the more common and more widely spread species *S. perigrina*, a leafy shrub, and *S. longifolia* a more tufted subacaulescent perennial.

It could be suggested that *S. purpurata* arose by hybridisation between *S. longifolia* and *S. perigrina* but at this stage proof is lacking.

A broad view is taken of the variation within the species *S. longifolia* Thunb. which results in the loss of specific status of *L. fergusonae* Bolus. The distribution range is from the coastal districts of the west via the mountainous region of Worcester and Robertson to Riversdale on the south coast and omitting the intervening coastal area of the Peninsula to Swellendam.

The type specimen of *L. amoenum* (C. H. Wright) R. A. Dyer, collected at Touws River by Bolus (BOL 1080) has not been matched exactly by other collections from neighbouring districts but several are regarded as specifically equal. A feature of the main specimen on the type sheet is the straight scape with up to 15 sessile spikelets. The scapes in most specimens are more branched and somewhat flexuous and with only about five spikelets. The type was obviously grazed short before it produced the new inflorescences and it is assumed that this caused the variation in habit. This view is supported by the habit of an isotype in the Kirstenbosch herbarium.

L. decumbens (Boiss.) O.K. was based on a specimen collected by *Drege*, no. 9374, without exact locality. Boissier stated that it was probably a monstrous form of an incompletely known species. It has fascicles of leaves on the inflorescence. No subsequent collection has been found to agree with it exactly. It is said to be distinctive in the pubescence of short tufted hairs on the scape and spikelets, while the calyx is described as quite glabrous. It seems that it is mainly the proliferous character which distinguishes it from *L. equisetum* (Boiss.) R. A. Dyer but in view of the circumstances no good purpose would be served by speculating further on the relationship between them.

As regards *L. scabrum* (Thunb.) O.K., I tried to establish a clear division between it, *L. corymbulosum* (Boiss.) O.K., *L. avenaceum* (C. H. Wright) R. A. Dyer and *L. penicillatum* Adamson, but failed to do so after the examination of a large number of specimens. However, because of the wide difference between extreme forms, three varieties are recognized.

On the other hand several specimens collected in S.W.A. in the vicinity of Luderitz and Angra Pequena and previously regarded as forms of *L. scabrum* appear sufficiently distinct to warrant specific rank. They differ from *L. scabrum* in the almost completely membranous bracts on mature scapes and their branches, in having 3–4-flowered spikelets and pedicellate flowers. In these latter characters and the pedicellate flowers the species shows an affinity with *L. dregeanum* but again the bracts are distinctive. The specimens are described under the new name *L. membranaceum*.

Other unusual specimens associated with *L. scabrum* and producing tufts of leaves on the flowering scapes, have been described under the name *L. foliosum* R. A. Dyer. Compton (18168) refers to the tufts of leaves within the inflorescence as a form of " vivipery ". This feature is found occasionally in other species also, such as *L. scabrum*. Had *L. kraussianum* (Buchnig ex Krauss) O.K. been recorded with *L. scabrum*, I would have been tempted to suggest that hybridisation had been at play to produce *L. foliosum*.

In the case of *S. linifolium* (L.f.) O.K., two varieties are recognized. The identity of the specimen described by L.f. has not been confirmed, but the speciment in Thunberg's herbarium (?type) matches several specimens collected later in the Port Elizabeth–Uitenhage districts. But this, the probable nomenclatural type form has a limited distribution, and the second variety given the name *maritimum* is far more widespread and occurs further east in the Cape (Transkei) than any other species. The two varieties cover much the same field of distribution as *L. scabrum*. The inter relationship between *L. linifolium* and *L. scabrum* is obscure but there are specimens, for instance *Britten* 5022, and others collected by *South* and *Compton*, at Port Alfred (Kowie) which seem to have some characters of both, with a greater leaning to *L. scabrum*.

The circumscription of *L. dregeanum* (Presl.) O.K. and *L. pedicellatum* (Wallr. ex Boiss.) O.K. entailed similar difficult decisions. Specimens described by Boissier under the name *Statice pedicellata*, were at one time considered to be specifically distinct

from *L. dregeanum* because of the differences in the branching of the scapes and general habit, one tufted and the other mainly cushion-shaped, but after several changes in opinion *L. dregeanum* alone has been maintained.

The taxonomy of the genus *Limonium* in southern Africa seems to bristle with problems, most of which require intensive field work to crystalize them out, let alone discover their explanation. Hybrid populations are suspected as occurring frequently on the south western coast. *L. anthericoides* (Schlechter) R. A. Dyer seems unique among the species. Although it exhibits a considerable degree of morphological variability, it does not seem to have been involved in any of the reproductive problems of any of its several neighbours in the rich Caledon, Bredasdorp, Swellendam region.

The new names and name changes consequent on the above notes are summarized below in alphabetical order.

Limonium depauperatum *R. A. Dyer*, comb. nov., stat. nov., *Statice equisetina* var. *depauperata* Boiss. in DC. Prod. 12: 658 (1847); Wright in F.C. 4, 1: 422 (1906). Type: Cape; *Burchell* 512 (G, lects.).

L. linifolium (*L.f.*) *OK.* var. **linifolium.**

L. linifolium var. **maritimum** (*E. and Z. ex Boiss.*) *R. A. Dyer*, comb. nov.
Statice linifolia var. *maritima* E. and Z. ex Boiss. in DC. Prod. 12: 657 (1848); Wright in F.C. 4, 1: 421. *S. linifolia* var. *brachyphylla* Boiss. in DC. Prod. 1.c. 657; Wright in F.C. 1.c. 421.

L. longifolium (*Thunb.*) *R. A. Dyer*, comb. nov.
Statice longifolia Thunb. Prod. 54 (1794). Type: Cape: Swartland, Thunberg (UPSV, holo.).
S. purpurata L. var. *longifolia* Boiss. in DC. Prod. 12: 667 (1848); Wright in F.C. 4, 1: 420 (1906) as to citation of *S. longifolia* Thunb.
Limonium fergusonae L. Bolus in J. S.A. Bot. 24: 124 (1934). Type: Riversdale, *Ferguson* BOL 20081 (holo.).

Limonium membranaceum *R. A. Dyer*, sp. nov., *L. scabro* (Thunb.) O.K. affine, sed bracteis scapi et ramulorum scapi fere omnino membranaceis, spiculis 3–4-floris differt.

Perenne caespitosum demum basi lignosum. *Folia* obovata vel oblanceolata vel lineari-oblanceolata, 2–4 cm longa 4–10 mm lata, obtusa, supra tuberculis centro punctato-impressis scabra, subtus levis vel tuberculis similibus paucis. *Scapi* nonnulli, tuberculis centro punctato-impressis scabri, patentes 10–20 cm longi, erecti etiam infra medium ramos steriles articulatim multifidos primum breves sursum sensim ampliatos edentes, superioribus floriferis dense fastigiato-corymbosis, articulis omnium densis brevibus strictis. *Spiculi* 3–4-flori, bractea exterior 3·5–4 mm longa, obtusa, margine membranacea glabra, pedicellis persistentibus 0·5–0·75 mm longis, truncatis. *Calyx* 4 mm longus, subcylindratus glaber 5-costatus, limbo membranaceo, lobis 5, c. 5 mm longis. *Petala* caerulea oblineari-lanceolata, plus 1 cm longa.

Endemic in southern South West Africa.

South West Africa.—Luderitz: *Pole Evans* H 19355; Kinges 2031; *Merxmüller* 2251 (PRE, holo. M, iso.). Angra Pequena: *Marloth* 1160; *Galpin* and *Pearson* 7490.

This species is allied to *L. scabrum* (Thunb.) O.K. and is distinguished by the almost completely membranous bracts on the scape, by the 3–4-flowered spikelets and pedicellate flowers. It is distinguished from *L. dregeanum* (Presl.) O.K. also by the membranous bracts, by the dense asperities on the scape, and by the broader leaves with dense asperities on the upper surface.

L. perigrinum (*Bergius*) *R. A. Dyer* comb. nov.
Statice perigrina Bergius, Descr. Pl. Cap. 80 (1767) excl. syn. Type C.B.S. Grubb. (SBT, holo) [collected by Auge fide Thunb. Fl. Cap. VII (1823)].

L. scabrum *Thunb.* var. **avenaceum** (*C. H. Wright*) R. A. Dyer.
Statice avenacea C. H. Wright in Fl. Cap. 4, 1: 423 (1906). Type: Bredasdorp, Ratels River Mouth, *Bolus* 8576 (K, holo. BOL iso.!).
Limonium avenaceum (C. H. Wright) R. A. Dyer in Kew Bull. 1932: 155.

L. scabrum (Thunb.) O.K. var. **corymbulosum** (Boiss.) *R. A. Dyer.*
Statice corymbulosa Boiss, in DC. Prod. 12: 658 (1848). Type: Camps Bay, Krauss (G, holo!).
Limonium corymbulosum (Boiss.) O.K. in Rev. Gen.: 2: 395 (1891).
L. penicillatum Adamson in S.A., Journ. Bot. 7: 202 (1941); Fl. Cap. Penin. 666 (1950) Type: Cape; Chapmans Peak, *Adamson* 859 (BOL holo).

L. scabrum (*Thunb.*) O.K. var **scabrum.**
L. scabrum (Thunb.) O.K. Rev. Gen. Pl. 2: 396 (1891). Type: Cape; *Thunberg* (UPSV holo.).
Statice scabra Thunb., Prod. 54 (1794).

R. A. Dyer

SCROPHULARIACEAE

Sutera dentatisepala *Overkott*, sp. nov., a *S. cooperi* Hiern planta annua minore, foliis non rigidis neque pallidis neque cordati-rotundatis, tubo corollae longiore lobis emarginatis; a *S. pristisepala* Hiern foliis non pinnatifidis, floribus maioribus non purpureis, lobis emarginatis differt.

Radix annua, fibrosa, griseo-brunnea. *Herba* foetida (teste coll.) ad 22 mm alta e basi multiramosa. *Caules* decumbentes vel ascendentes, foliosi, basin versus saepe radicantes, leviter quadranguli, superne fere teretes et florigeri; ubique pilis satis longis, perspicuis, glandulosis, fusci-capitulatis et paucis pilis simplicibus obtecti. *Folia* membranacea, opposita, omnia breviter petiolata, petiolis planis ad 6 (–12) mm longis, glandulosi-pilosis, in axillis saepe ramulos parvos foliosos gerentia, rotundati-triangulata, basi late cuneata, margine irregulariter dentata vel leviter pinnatisecta, utrinque glandulosa, ad 10 (–20) mm longa, ad 8 (–17) mm lata, nervis alternantibus pinnatis, superne immersis, subtus prominentibus, pilos conspicuos gerentibus. *Internodia* 12–27 mm longa. *Flores* plerumque alternantes, albi vel rosei, lutei-ocellati in axillis bractearum foliis similium quamquam minorum. *Pedicellus* ad 5 mm longus, calyce brevior. *Calyx* ad 7 mm longus, ut caulès intus et extus glandulosi-pilosus, ad basin fere divisus. *Sepala* cuneata, apice 1–7 dentata vel mucronata. *Tubus corollae* calyce 2·5-plo longior, ad 18 mm longus, extus glandulosi-pilosus, apice leviter ampliatus. *Limbus* pro rata latus, subtus glandulis sessilibus insitus, lobis obcordatis, leviter vel distincte emarginatis, ad 5·5 mm longis, ad 3 mm latis. *Faux* glandulosa et pilosa. *Stamina* inclusa. *Antherae* reniformes inter se aequales, superiores paulo minores. *Thecae* confluentes. *Filamenta* glandulosa, superiora breviora, ad 1·2 mm, inferiora ad 2 mm longa et in tubus decurrentia, omnia in parte tertia superiore tubi inserta. *Ovarium* angustum, ad 2·5 mm longum, apice dense glandulosum. *Stylus* crassus, plerumque glaber, apice brevissime bilobatus, longe persistens. *Fructus* non vidi.

Natal.—Bergville District: on boulder bed of Tseketseke River, Cathedral Peak Forestry Station, 6,700 feet, *Killick* 1827 (PRE, holo.). Estcourt District: Giants Castle, *Symons* (Transvaal Museum No. 25157, PRE).

Basutoland.—Likoloberg, grassy gravelly patch on hill, 9,300 feet, *Guillarmod* 716 (PRE); Mamalapi, streambank, 8,000 feet, *Guillarmod* 677 (PRE); Mamalapi, streambanks, 9,000 feet, *Compton* s.n. (NBG); Machochi, *Seligman* s.n. (BM); without precise locality, *Staples* 259 (PRE).

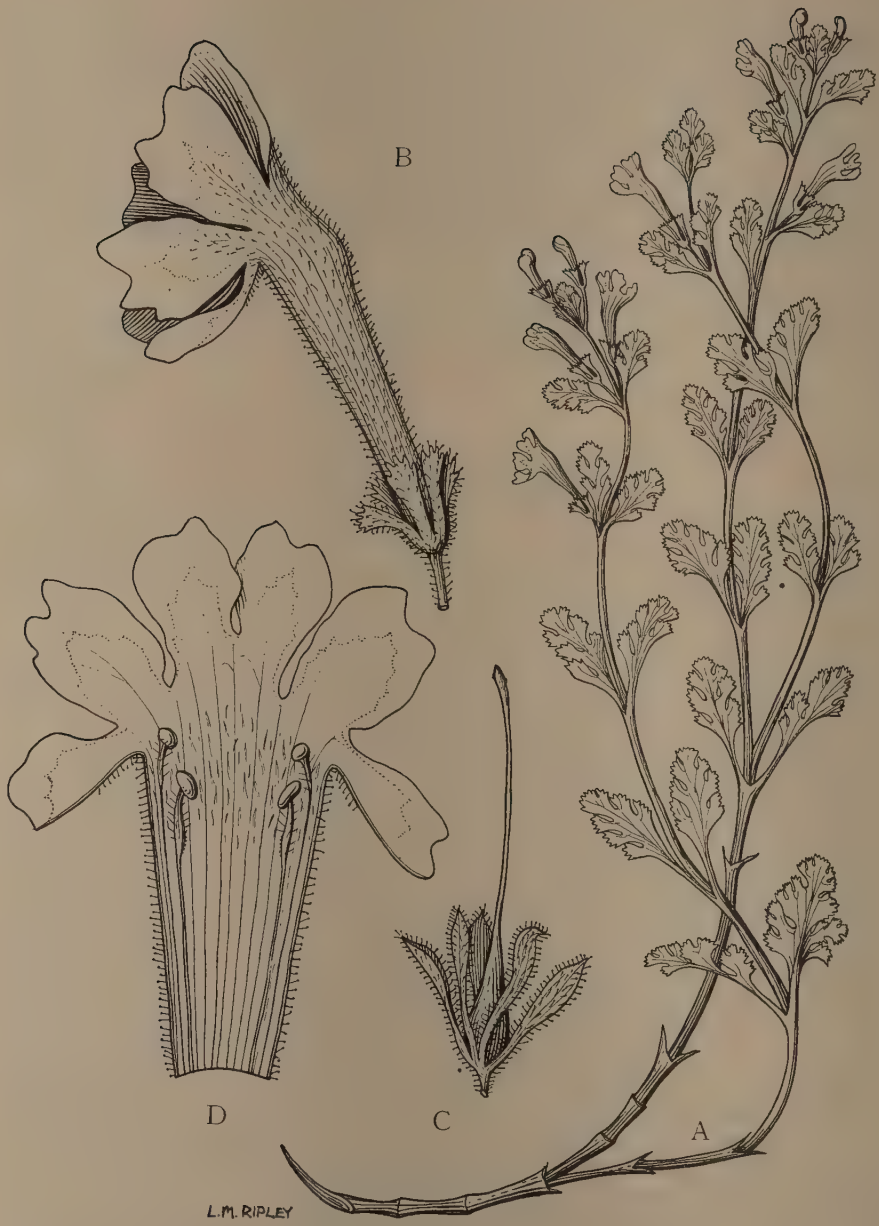

FIG. 6.—*Sutera dentatisepala* Overkott; A, habit, × ⅔; B, flower, × 3; C, calyx and pistil, × 3; D, flower opened out, × 3.

Decumbent or ascending, probably annual herb, about 25 cm high, much branched from the base. *Leaves* opposite, rotundate-triangulate, broadly cuneate at the base; petioles shorter than the leaves, sometimes bearing short foliate branchlets in the axils. *Bracts* leaflike, but smaller. *Flowers* white or mauve with orange centres, alternate, axillary, subterminal, not very numerous; peduncles shorter than the bracts; calyx deeply 5-cleft, segments cuneate at the base, with one to seven teeth at the ends, as branches and leaves covered on both sides with short, gland-tipped hairs and globose sessile glands; tube about 18 mm long, glandular puberulous outside, lobes ± emarginate; *Stamens and style* enclosed in the tube; filaments glandular, the upper one shorter than the lower ones. *Ovary* small, with numerous sessile glands; style stout, persistent.

O. Overkott

TURNERACEAE

Turnera thomasii (*Urb.*) *Story*, comb. et stat. nov. *T. ulmifolia* L. var. *thomasii* Urb. in Engl. Bot. Jahrb. 25 Beibl. 60: 11. *Loewia thomasii* (Urb.) Lewis in Kew Bull. 1953: 431.

Turnera oculata *Story*, sp. nov., *T. ulmifoliae* L. et *T. thomasii* (Urb.) Story a ffinissed ita differens: a *T. ulmifolia* ramis rigidibus, a *T. thomasii* petalis flavis, indumento breviori, antheris multo crassioribus.

Frutex erectus tenuis ad 2 m altus, foliis ramulisque junioribus villis simplicibus stellatisque dense pubescentibus. *Folia* alternantia simplicia; lamina ad 3 cm longa 2 cm lata, obovata vel late elliptica, apice rotundato vel acuto, praeter basin cuneatam serrata, pinninervata, nervis utrinque plus minusve 6, basi saepe glandulis prominentibus 1 vel 2; petiolus ad 1 cm longus; stupuli minuti. *Inflorescentia* terminalis. *Bracteae* 2 lineares 1 cm longae, superne profunde canaliculatae. *Flos* axillaris solitarius, pedicello petiolo adnato. *Calyx* intus paene glaber; tubus 1·2 cm longus 3 mm diametro, nervis 10; lobi tubo calycino interdum aequilongi saepius longiores, acuminati, basi 3 mm lati, interdum margine tenue pellucido ad 2 mm lato. *Corolla* in faucibus tubi calycini inserta; petala alterna ac lobi calycini, obovata, apice acuto, imbricata, 2·5 cm longa, in parte latissima 1·8 cm lata, superne laete flava, inferne saturate rubri-brunnea, glabra. *Androecium* staminibus 5, fertilibus; filamenta lobis calycinis opposita, circiter 3 mm infra calycis fauces inserta, villis basi paucis alibi glabra, 2·2 cm libera, inferne 1 cm tubo calycino adhaerentia; antherae c. 7 mm longae, basi emarginatae, paullo super basin dorsifixae summum filamentum saepientes. *Gynoecium* stylis 3 glabris liberis quam stamina paullo longioribus; stigma fimbriatum; ovarium superius cylindratum apice obtuso, in siccitate 5-costatum, ovulis ad 120 in placenta stipatis. *Capsula* 3-valvata, valvis ovatis 9 mm longis in parte latissima 5 mm latis, placenta parietali; funiculus prope basin seminis affixus; semina matura curvata, 4 mm longa; arillus incisus membranaceus, semen superans.

South West Africa.—Kaokoveld: sandy bed of watercourse 12 miles south of the Kunene River, latitude 17° 22′ longitude 12° 30′ *Story* 5778; sandy banks of Kunene River at Otjinungua, *de Winter and Leistner* 5770 (PRE, holo.).

An erect slender shrub up to 2 m high, younger parts densely pubescent with simple and stellate hairs, branches sometimes abbreviated, with crowded small leaves, afterwards deciduous or elongating and permanent. *Leaves* velvety, dull light green, simple, very variable in size; lamina up to 3 cm long and 2 cm broad, obovate to broadly elliptic, rounded or acute at the apex, apiculate-serrate except at the cuneate base, alternate, divergent, pinnately nerved with about six pairs of nerves more prominent below, often with one or two conspicuous hollow glands (2 × 1 mm) on the margin at the base; petiole up to 1 cm long; stipules minute, free, exuding a drop of resin

from the glandular tip. *Inflorescence* terminal; bracts 2, linear, 1 cm long and deeply channelled adaxially, with sometimes one or several glands like those found on the leaves but much smaller. *Flower* axillary, solitary, with pedicel fused to petiole and thus at first sight apparently sessile and borne at the distal end of the petiole. *Calyx* almost glabrous within; tube about 12 mm long and 3 mm in diameter, widening at the throat, and with 10 veins of which five continue down the centres of the lobes and five fork between the bases of the lobes to form two marginal veins; lobes sometimes as long as the calyx tube, but more often 3 or 4 mm longer, acuminate, 3 mm wide at the base, sometimes with a thin translucent margin up to 2 mm wide. *Corolla* inserted in the throat of the calyx tube; petals alternating with the calyx lobes, obovate, acute at the apex, abruptly narrowed below, imbricate, 2·5 cm long, 1·8 cm wide at the widest part, bright yellow above, dark red-brown towards the base, glabrous. *Androecium* of 5 stamens, all fertile; filaments inserted about 3 mm below the throat of the calyx tube and alternating with the petals, glabrous except for a few hairs near the base, free for about 2·2 cm, below this with thin transparent margins adherent to the calyx-tube and a thicker central part free to the base, this fixed portion being about 1 cm long; anthers 7 mm long, narrowly oval, emarginate at the base, dorsifixed a little above the base and enclosing the tip of the filament; thecae dihiscing longitudinally.

FIG. 7.—*Turnera oculata* Story; 1, seed, × 10; 2, stigma, × 10; 3, anther, × 10; 4, leaf-glands, × 10; 5, flower, × 1·5.

Gynoecium with 3 glabrous free styles a little longer than the stamens; stigma fimbriate; ovary superior, cylindric, obtuse, 5-ridged when dry, ovules up to 120, crowded on the placenta. *Capsule* 3-valved; valves ovate, 9 mm long, 5 mm broad at the broadest part, thickened on the margin, reticulate within, with parietal placenta; funicle attached just above the base of the seed and remaining on the placenta after the seed is shed, thickened near the hilum; mature seeds curved, 4 mm long, with hilum near base on concave side, abortive seeds conspicuous by reason of the rudimentary aril; aril lobed, incised, membranous, roughly triangular, with one lobe overtopping the seed on the concave side and two almost encircling the base.

This plant was first recorded in 1956 in a sandy gully about 12 miles south of the Kunene River in South West Africa at longitude 12° 30', latitude 17° 22', and has so far been found only in that vicinity. It is not common and usually occurs in small patches of a dozen or so. It has been found in bloom in May and August, conspicuous because of the large bright flowers and silvery leaves and erect habit. As one of the several young plants collected in the field has survived a severe winter in Pretoria and seems well established, it is likely that *Turnera oculata* could be cultivated fairly widely in the Union.

The plant runs to *Turnera* in Thonner's key and its other characters are also strongly in support of its inclusion under *Turnera*, and I therefore do not feel justified in placing it in the closely related genus *Loewia*, even though *Loewia* is upheld in the Flora of Tropical East Africa (Lewis 19/2/54, 1.c.: 1 et seqq.). The two genera are separable as follows:—

1. *Turnera* has a 10-nerved calyx-tube, *Loewia* has the calyx-tube traversed by 35–40 bundles of very slender vessels (Urban 1897, Ann. R. Inst. Bot. Rom. 6: 189).

2. *Turnera* has no secretory hairs, *Loewia* has tubercles secreting resin (Urban 1.c.). (These " tubercles " are resin-like nodules, probably swollen hair-bases.)

3. *Turnera* has the stigma fimbriate—" capillaceo-multifidum "—(Linn. Gen. ed. 2: 105 para. 297), *Loewia* according to Urban (1.c.), Thonner, and Hooker (Icon. 3015) has it capitate or with the margin sub-entire. (Lewis says of *L. tanaensis* that the stigma is fimbriate but shows it lobed in the sketch.)

In all these characters the plant here described agrees with *Turnera*. Additional reasons for keeping it separate from *Loewia* are as follows:—

1. In *Loewia* the calyx-tube is about two-thirds the length of the whole calyx, in this plant it is less than half the total length.

2. *Loewia* has the seeds bi-seriate on the placenta (Urban 1.c.), this plant has them crowded.

3. *Turnera* may have the pedicels fused with the petioles (R. Hort. Soc. Dic. of Gard. 1951 Vol. 4: 2170; Hooker's Jour. Bot. 4, 1842: 115), in *Loewia* they are free. This plant has them fused.

4. *Turnera* may have conspicuous hollow glands on the basal margins of the leaves, in *Loewia* they are absent. This plant has them, though not consistently so.

Two inconsistencies in the literature should be pointed out. They are as follows:—

1. Urban (1.c.) says that in *Loewia* the margin of the aril is sub-entire, but Hooker (Icon. 3015) says of Urban's species *L. tanaensis* that the margin is lacerate. Hooker's statement has been checked at Kew and found to be correct.

2. Lewis (Flor. Trop. E. Afr. 1954) says the pits on the seed of *Loewia* are two-pored, Urban (1.c.) says they have no pores. The specimens at Kew indicate that Urban is correct.

For the following reasons I am including *Loewia thomasii* (Urb.) Lewis under *Turnera*:—

1. It has no secretory hairs.
2. The calyx is tubular for less than half the total length.
3. The pedicels are fused with the petioles.
4. There are conspicuous hollow glands on the basal margins of the leaves.
5. The calyx-tube is 10-nerved.
6. The stigma is fimbriate (described incorrectly by Urban as very shortly lobed).

The available records indicate that *Turnera thomasii* has been collected only twice. The first collection is by F. Thomas (No. 47) from Witu in the Lamu district of Kenya, and is the type. The holotype was destroyed in Berlin, and there remains only the isotype, which is at Kew. The second collection is by P. Bally (No. 2092) at Mahoney Road, near Muddo Gasha in the Northern Province of Kenya, and is represented in the Kew and Nairobi herbaria.

I am grateful to Mr. W. Marais, who went through the material and literature at Kew on my behalf and gave me much useful information.

R. Story

The Virus Diseases of *Crotalaria*, *Glycine* and *Medicago* Species

by

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This report concerns the naturally occurring virus diseases of the following plants:— *Crotalaria juncea* (sunnhemp), *C. spectabilis*, *Glycine max* (soybean), *G. javanica* and *Medicago sativa* (lucerne or alfalfa).

Throughout South Africa, these genera are used either for fodder, as cover crops, or, to a lesser extent, for oil extraction.

Further details of some of the diseases found on these plants, will be found in the reports on bean and broad bean virus diseases, as the viruses were apparently related to those groups.

Methods and materials

The viruses were isolated from plants collected mainly in the Transvaal, but also from the Stellenbosch district and from near Salisbury, Southern Rhodesia.

The standard test plants were: *Phaseolus vulgaris* var. Canadian Wonder, *Vicia faba* var. Aquedulce, *Pisum sativum* var. Greenfeast and *Vigna unguiculata* var. Dr. Saunder's Upright.

Carborundum powder was used for the mechanical sap inoculations, and *Aphis craccivora* was used in the insect transmission tests.

There are three separate sections, dealing with the viruses of (A) *Crotalaria* spp. (B) *Glycine max* and (C) *Medicago sativa* and *Glycine javanica.*

Each section has its own bibliography and plates.

CROTÁLARIA VIRUS DISEASES

Crotalaria juncea, sunnhemp, is cultivated extensively in South Africa as a green manure crop. *Crotalaria spectabilis* is also used for this purpose but on a smaller scale.

Both species are subject to natural infection by several viroses in the field, and are also susceptible to many others when inoculated artificially.

With two exceptions, these virus diseases have been described in previous papers, as they were obviously related to other viruses viz. the bean local chlorosis, the bean chlorotic ringspot, the bean necrosis and the bean necrotic speckle viruses. Also, a strain of the broad bean mosaic virus was found on naturally infected *C. spectabilis.*

The two exceptions, which will be described in detail in this paper, are the alsike clover mosaic virus and the white clover mosaic virus complex. Both are well-known elsewhere, but are recorded for the first time in South Africa.

The symptoms caused on most host plants, by what is considered to be the white clover mosaic virus, are very similar to those described by Zaumeyer and Wade (19). No attempt has been made to split the components [see Johnson (13)], but the virosis as found in the field is described as a whole.

The symptoms caused by the several viruses on *C. juncea* are very similar—the differences are found in the degree of malformation, mottling or necrosis rather than in the type of symptom. They are only differentiated by the effect of the virus on other plants.

On *C. spectabilis* the symptom picture does vary—some viruses cause vivid yellow streaks, while others result in mottling with necrosis.

Nevertheless, they are not characteristic enough for certain identification, and alternate hosts must be used.

Review of literature

The first report of probable virus infections of *Crotalaria* species was that of Schwartz, 1927, who described a witch's broom and crinkle disease of *C. juncea* and *C. anagyroides* in Java (17).

In 1931, Illingworth (11) noted a mosaic of *Crotalarias* in pineapple fields in Hawaii, and Cook (5, 6) worked on a mosaic disease of *C. striata* in Puerto Rico. Other mosaic diseases of *Crotalaria* spp. were found in Japan by Fukushi (8), and in Trinidad by Dale (7).

Raychaudhuri (15) noted a mosaic disease which is confined to sunnhemp only (*C. juncea*) and Capoor (4) described the Southern sunnhemp mosaic virus which withstands very high temperatures and ageing.

Gates (9) reported mosaic and "little leaf" diseases of *C. spectabilis*, Jenson (12) worked on the aphid transmission of a mosaic of *C. incana* and Raychaudhuri and Pathanian (16) found a mosaic of *C. striata.*

Viruses causing a witch's broom symptom on *Crotalaria* spp. were recorded by Johnson and Lefebvre (14) who were able to transmit the virus to broad bean; and Hadiwidjaja (10) who transmitted the virus by grafting and by *Cuscuta.*

Bose and Misra (3) reported a graft-transmissible virus which caused structural abnormalities of sunnhemp flowers. This was later proved to be due to two viruses—one sap-transmissible, and the other, probably tobacco leaf-curl transmitted by *Bemisia tabaci* (1).

According to Zaumeyer (18), mosaic symptoms can be induced on *Crotalaria* spp. by artificial inoculation with several legume viruses viz. alsike clover mosaic viruses 1 and 2 and pea mosaic viruses 4 and 5.

ALSIKE CLOVER MOSAIC VIRUS 1 Zaumeyer and Wade.

Natural source of virus: *Crotalaria juncea.*

The young leaves showed a chlorotic speck mottle and they had wavy margins. The middle leaves had constrictions across the laminae, and irregular-shaped dark green islands on a light green background. The lower leaves were normal in shape but had dark green veinbands or midrib. Fig. 1A.

Physical properties: Thermal inactivation point 62–64°C. Longevity *in vitro* 1–2 days. Dilution end point 1:3000–1:5000.

Transmission: Mechanical sap inoculation. *Aphis craccivora.*

Host range: *Crotalaria juncea* L., *C. spectabilis* Roth., *Dolichos lablab* L., *Glycine javanica* L., *G. max* (L.) Merr., *Lathyrus odoratus* L., *Lupinus albus* L., *L. luteus* L., *L. mutabilis* Sweet., *Medicago lupulina* L., *Melilotus officinalis* Willd., *Phaseolus acutifolius* Gray var. *latifolius* Freem., *P. lunatus* L., *P. mungo* L., *P. vulgaris* L., *Pisum sativum* L., *Trifolium hybridum* L., *T. incarnatum* L., *T. pratense* L., *Vicia faba* L., *Vigna sesquipedalis* (L.) Wight., *V. unguiculata* (L.) Walp., *Voandzeia subterranea* Thouars.

Reaction of susceptible species

Crotalaria juncea.

Local. Necrotic lesions may develop.

Systemic. In nine days chlorotic spots develop on the young leaves. Later leaves have a mottle or mosaic with dark green blisters or veinbands. These leaves are puckered, malformed and elongated. There may also be necrotic specks. Fig. 1B. The plant is stunted and rosetted.

C. spectabilis.

Local. Chlorotic spots may develop.

Systemic. There are chlorotic spots on the young leaves in 19 days. Later leaves are chlorotic with dark green veinbands and there is a necrotic sheen. These leaves are malformed and puckered.

Dolichos lablab.

A symptomless carrier.

Glycine javanica.

Local. There are chlorotic spots in seven days.

Systemic. There may be a chlorotic spotting or mottle.

G. max.

Local. Chlorotic spots develop in seven days.

Systemic. There may be chlorotic areas, but usually the virus is latent.

Lathyrus odoratus.

Local. No reaction.

Systemic. The leaves are rolled and mottled.

Lupinus albus var. Sweet.

Local. The leaves drop after a severe necrosis in three days.

Systemic. In 16 days the young leaves develop a vein clearing and spotting and they remain folded, and have wavy margins. Later leaves are mottled and malformed and may have necrotic specks. The plant is rosetted and many leaves drop.

L. albus var. Bitter.

Local. No reaction.

Systemic. The young leaves remain folded and have curled tips. Later leaves are mottled or generally chlorotic and the plant is rosetted.

L. luteus.

Local. No reaction.

Systemic. The young leaves remain folded and have wavy margins. Chlorotic spots develop in 20 days. Later leaves are small, malformed (stringlike) and generally chlorotic. There may be necrosis and many leaves drop. The plant is rosetted.

L. mutabilis.

Local. No reaction.

Systemic. The leaves are malformed and stringlike, and very chlorotic. The plant is rosetted.

Medicago lupulina.

Local. No reaction.

Systemic. After a vein clearing there are vivid chlorotic streaks and areas, and the leaves are crinkled. Fig. 1C.

Melilotus officinalis.

Local. No reaction.
Systemic. The young leaves develop chlorotic spots and streaks. Later leaves are mottled, small and malformed.

Phaseolus acutifolius.

Local. In six days there are chlorotic spots and necrotic veins.
Systemic. The young leaves develop a vein clearing and then necrosis in the veins. Later leaves are mottled.

P. lunatus.

Local. Chlorotic ringspots develop in six days.
Systemic. There is a chlorosis of the veins which soon becomes necrotic.

P. mungo.

Local. There are chlorotic spots in eight days.
Systemic. There is a chlorotic spotting on most leaves.

P. vulgaris var. Canadian Wonder.

Local. No reaction.
Systemic. A chlorotic network develops on the young leaves, and later ones have a chlorotic spotting and then a mottle. There are dark green areas and veinbands and the leaves are puckered.

var. Haricot.

Local. No reaction.
Systemic. After a chlorotic network and spotting, the leaves develop a mottle. The leaf surface is puckered and many leaves drop. There may be a slight malformation.

Pisum sativum.

Local. No reaction.
Systemic. The young leaves develop a chlorotic network in 15 days. Later leaves have chlorotic spots or a mottle, and are malformed. The old leaves have a white etching. Fig. 1D. The tendrils are abnormally curled, and the plant is stunted.

Trifolium hybridum.

Local. No reaction.
Systemic. There is a vein clearing and chlorotic spotting followed by a chlorotic streaking.

T. incarnatum.

Local. There may be dark green rings on the chlorotic leaves.
Systemic. The young leaves show a vein clearing after six days, then chlorotic spotting or vein flecking. Later leaves have a mosaic and are crinkled and rosetted.

T. pratense.

Local. No reaction.
Systemic. There may be chlorotic streaks or the plant may be a symptomless carrier.

Vicia faba.

Local. No reaction.
Systemic. Only a diffuse chlorotic mottle develops.

Vigna sesquipedalis.

Local. There are chlorotic spots in seven days.
Systemic. In 15 days the young leaves develop a vein clearing and chlorotic spotting. Later leaves are mottled.

V. unguiculata.

Local. Chlorotic spots may develop.
Systemic. There may be a vein clearing followed by a chlorotic mottle, or the leaves may be symptomless.

Voandzeia subterranea.

Local. There are chlorotic areas in seven days.
Systemic. The symptoms are masked.

IDENTIFICATION.

This virus is very similar to the alsike clover mosaic virus 1 Zaumeyer and Wade (19). The only difference is that on the broad bean, Zaumeyer's virus induces a severe mottle and malformation, whereas this virus causes only a diffuse mottling. This difference may be due to temperature or varietal factors.

Nevertheless, it is considered the same as, or closely related to the alsike clover mosaic virus 1.

WHITE CLOVER MOSAIC VIRUS Zaumeyer and Wade.

Natural source of virus: *Crotalaria spectabilis.*
The younger leaves showed a chlorotic mottle, and the older ones, a dark green vein banding. There were necrotic stem streaks. Fig. 2C.

Physical properties: Thermal inactivation point 56–58°C. Longevity *in vitro* 1–2 days. Dilution end point 1:1000–1:2000.

Transmission: Mechanical sap inoculation.

Host range: *Arachis hypogaea* L., *Crotalaria juncea* L., *C. spectabilis* Roth., *Dolichos lablab* L., *Glycine javanica* L., *G. max* (L.) Merr., *Lathyrus odoratus* L., *Lupinus albus* L., *L. luteus* L., *L. mutabilis* Sweet., *Medicago lupulina* L., *M. sativa* L., *Melilotus officinalis* Willd., *Phaseolus acutifolius* Gray var. *latifolius* Freem., *P. lunatus* L., *P. mungo* L., *P. vulgaris* L., *Pisum sativum* L., *Trifolium hybridum* L., *T. incarnatum* L., *T. pratense* L., *T. repens* L., *Vicia faba* L., *Vigna sesquipedalis* (L.) Wight., *V. unguiculata* (L.) Walp., *Voandzeia subterranea* Thouars.

Reaction of susceptible species

Arachis hypogaea.

Local. No reaction.
Systemic. Chlorotic spots develop on the young leaves; on later formed ones, there is a chlorotic streak mottle.

Crotalaria juncea.

Local. Within a week there are chlorotic spots and necrotic veins. The leaves soon drop.
Systemic. In nine days the young leaves develop a vein clearing and chlorotic spotting. Later leaves are small and crinkled, and have a mosaic and a necrotic sheen. There are often necrotic stem streaks which cause the plant to curve to one side.

C. spectabilis.

Local. No reaction.

Systemic. The young leaves develop a chlorotic flecking and the next formed have a mottle. Later leaves develop a vein banding with a slight necrosis which causes a crinkling of the leaves.

Dolichos lablab.

Local. Chlorotic spots develop in 5–6 days.

Systemic. No reaction.

Glycine javanica.

A symptomless carrier.

Glycine max.

Local. Small necrotic specks with chlorotic haloes develop in 10 days.

Systemic. At the same time the young leaves develop a vein-clearing and chlorotic spotting. Later leaves have a mottle with necrosis developing in the chlorosis. This results in a puckering of the leaf surface.

Lathyrus odoratus.

Local. No reaction.

Systemic. After two weeks most leaves develop a chlorotic streak mottle and they are rolled.

Lupinus albus.

Local. In nine days necrotic specks and veins develop, leaving a chlorotic background. The leaflets soon drop.

Systemic. The young leaves show a veinclearing and spotting with necrotic specks. Later leaves are mottled and rolled, and the necrosis spreads until most leaves have dropped leaving the rosetted petioles. Any secondary shoots have small malformed leaves with dark green blisters.

L. luteus.

Local. In 10 days there are chlorotic spots.

Systemic. At the same time the young leaves develop a chlorotic network or vivid rings. Later leaves are mottled and malformed, and they remain folded. The older leaves have chlorotic spots with necrotic rings. The plant is severely stunted and rosetted.

L. mutabilis.

Local. No reaction.

Systemic. The leaves curl up, and are small and chlorotic. The plant is rosetted and stunted.

Medicago lupulina.

Local. No reaction.

Systemic. The leaves show chlorotic streaks and a dark green midrib. The plant is stunted.

M. sativa.

Local. No reaction.

Systemic. The young leaves develop chlorotic spots in three weeks. Subsequent ones show almost yellow spots or irregular areas.

Melilotus officinalis.

Local. There are dark green rings on chlorotic leaves.

Systemic. The young leaves show diffuse chlorotic spots. Later ones develop an irregular chlorotic mottle.

Phaseolus acutifolius.

Local. There is no reaction but the leaves drop.

Systemic. In 8–10 days there is a veinclearing and curling of the young leaves. Later ones are small and malformed, and have dark green blisters.

P. lunatus.

Local. In 10 days there are necrotic specks with chlorotic haloes, and a veinal necrosis.

Systemic. The first and second trifoliates develop necrotic rings, and the young leaves have chlorotic specks with necrosis setting in.

P. mungo.

Local. In 10 days there are necrotic lesions.

Systemic. Some leaves have chlorotic specks which later become necrotic.

P. vulgaris var. Canadian Wonder.

Local. There are necrotic lesions or ringspots and a slight veinal necrosis.

Systemic. No reaction.

var. Haricot.

Local. Within a week there may be small chlorotic spots with necrotic rings, or only a veinal necrosis.

Systemic. The young leaves develop a veinal necrosis which spreads to the petioles and stem, and the plant collapses.

vars. Black Wonder, Long Tom, S.A. Black and White and Tendergreen develop large local necrotic spots and veins in three days. There are also areas of almost yellow chlorosis on which the necrotic lesions are vividly marked. Fig. 2B.

var. Idaho Refugee has only a local necrotic vein etching.

Pisum sativum.

Local. There are no lesions, but in 10 days the leaves have become necrotic and wilted.

Systemic. After a veinclearing and spotting of the young leaves, the next formed develop a mosaic. Necrosis sets in, in the chlorotic areas and in the veins, and the plant collapses. Secondary shoots have small, folded and mottled leaves, and the tendrils are abnormally curled.

Trifolium hybridum.

Local. There are chlorotic spots.

Systemic. After three weeks chlorotic spots develop on the young leaves while later ones have a chlorotic streak mottle.

T. incarnatum.

Local. A veinal necrosis results in a collapse of the leaves.

Systemic. In 18 days the veins of the young leaves become chlorotic then necrotic. Later ones are severely crinkled and puckered and have a mottle. The plant is extremely stunted and normally collapses.

T. pratense.

Local. No reaction.

Systemic. There are chlorotic streaks which become necrotic and cause a malformation of the leaf surface.

T. repens.

Local. No reaction.

Systemic. There are chlorotic streaks but less necrosis and malformation than on *T. pratense.*

Vicia faba.

Local. In two weeks chlorotic spots with almost purple necrotic rings develop. The leaves wilt.

Systemic. A week later the young leaves show a veinclearing and chlorotic spotting. On later formed leaves these spots have necrotic haloes (Fig. 2A), and there is a necrosis of the growing point, which may collapse. Any secondary shoots which develop have leaves which are rolled and have a mosaic.

Vigna sesquipedalis.

Local. Chlorotic specks develop in two weeks. These fuse to a general chlorosis and the leaves wilt.

Systemic. The second trifoliates have chlorotic rings and a necrotic sheen. The young leaves are spotted and later mottled.

V. unguiculata.

Local. In two days there are necrotic specks and in six there are chlorotic areas.

Systemic. A week later the young leaves develop necrotic veins and they are curled down, and soon absciss. If more leaves form they are slightly malformed with irregular areas of chlorotic spots along the veins.

Voandzeia subterranea.

Local. No reaction.

Systemic. A dark green blistered mottle develops on most leaves.

IDENTIFICATION

There is a great resemblance between this virus and the white clover mosaic virus as described by Zaumeyer and Wade (19).

Although the symptoms on all host plants are not identical, they are very similar. Also, the physical properties and host ranges of the two viruses are alike.

Therefore, this virus is considered the same as the white clover mosaic virus.

(No attempt has been made to isolate the two components, but the virus is described as it was found in the field.)

SUMMARY

In South Africa, three viruses occur naturally on *Crotalaria juncea*, viz. the alsike clover mosaic virus and strains of two bean viruses (described in the report on bean virus diseases).

On *C. spectabilis* there are four viruses which occur in the field—the white clover mosaic virus (as a complex), two bean viruses and one related to the broad bean mosaic virus (described under their respective headings).

Of these seven viruses, not one can be correlated with the *Crotalaria* viruses already reported in the literature.

The viruses of Bose and Misra (3) and Hadiwidjaja (10) both cause a witch's broom effect, which is not a feature of any of these viruses.

Gate's two diseases of *C. spectabilis* are not sap-transmissible (9), and the sunnhemp

mosaic of Raychaudhuri (15) has only one host viz. sunnhemp. Although the viruses of Capoor (4) and Raychaudhuri and Pathanian (16) have much wider host ranges, their physical property values are very high e.g. Capoor's virus withstands heating up to 90°C, and ageing to 557 days.

Too few details are available of the other *Crotalaria* diseases, for an accurate comparison to be made.

Schwartz (17), Cook (5), Illingworth (11), Fukushi (8) and Jenson (12) give only the symptoms on *Crotalaria* species. Dale (7) does include cowpea as a susceptible host, and Johnson and Lefebvre (14) describe only the reaction on broad bean.

It is therefore concluded that none of these *Crotalaria* viroses have been found during this survey in South Africa.

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SOYBEAN VIRUS DISEASES

In the field, soybean (*Glycine max*) is apparently susceptible to three viruses—one of which is the seed-borne soybean mosaic virus.

This soybean mosaic virus has been found in the Northern, Eastern and Western Transvaal—but probably occurs wherever soybeans are cultivated, as the percentage of infected seed can be high.

The other two viruses found on naturally infected soybeans are described in detail in the report on bean virus diseases; as they were proved to be strains of the bean chlorotic ringspot and bean local chlorosis viruses.

The field symptoms of the latter two viruses include mottling, puckering and malformation of the leaves, and stunting of the plants.

Review of literature

Clinton 1916, was the first to report a chlorosis and crinkling of soybean leaves. The virus origin of this chlorosis was established by Gardner and Kendrick in 1921. Pierce (11) named the causal organism soybean virus 1, and in Kenneth Smith's classification it is *Soja* virus 1.

The virus can be transmitted in the seed of infected plants where it can survive for two years, Kendrick and Gardner (8). It is also aphis transmitted.

Heinze and Köhler (6) and Conover (3) were able to infect *Phaseolus vulgaris* and *Vicia sativa*, but these hosts have not been confirmed by other workers.

Savulescu *et al* (12) described three types of symptom on soybeans—leaf curl, brown mosaic and yellow mosaic. These variants have a thermal inactivation point of 80°C., which is much higher than is generally accepted for the soybean mosaic virus.

According to Ling (10) the only legume viruses found on naturally infected soybeans are the bean yellow mosaic virus and the cowpea mosaic virus of Dale.

However, many other legume viruses can induce symptoms on soybeans when inoculated artificially.

The top necrosis, streak and budblight diseases of soybean are now attributed to strains of the tobacco ringspot virus. Allington (1) and Johnson (7). This virus is also seed-transmitted in soybeans. Desjardins *et al* (4).

The tomato spotted wilt virus results in local necrotic specks surrounded by chlorotic haloes. The rest of the leaf may be almost orange in colour. There is no systemic reaction. (See report on pea virus diseases.)

SOYBEAN MOSAIC VIRUS Gardner and Kendrick.

Transmission: Mechanical sap inoculation. By seed. (One land had approximately 35%.) Aphis. (Species not determined.)

Host range: *Glycine max* (L.) Merr.

Symptoms on *Glycine max*:

(*a*) Artificial infection in the glasshouse:

Local. No reaction.

Systemic. The young leaves develop chlorotic spots in three weeks. This is followed by a mottle and slight malformation on the next formed leaves. Often, necrotic rings develop round the chlorotic spots as the leaves mature.

The plant is stunted, and has a proliferation of secondary shoots which remain rosetted.

(*b*) Natural infection in the field:

In a land of maturing soybeans, infected plants are noticeable for their lush green foliage, when other plants have dropped most of their leaves.

These plants are stunted, and have a great number of lateral branches.

The leaves are mottled, crinkled and slightly malformed. They later become leathery.

(*c*) Seed infection in the glasshouse:

The primary leaves are mottled and crinkled with wavy margins. The trifoliates have the usual symptoms.

The plants are spindly and etiolated.

IDENTIFICATION

As this virus is seed-borne, and has only one host plant viz. the soybean, there can be little doubt that it is the soybean mosaic virus.

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LUCERNE (ALFALFA) MOSAIC VIRUSES

The typical lucerne mosaic virus occurs naturally on lucerne in many districts of the Union.

One variant of this virus was found in the Western Cape, also on lucerne; and another was isolated from *Glycine javanica* growing in experimental plots in Pretoria. These three viruses will be described below.

The necrotic ring strain of lucerne mosaic virus, which was commonly found on naturally infected peas and sweet peas, has been described in the report on the virus diseases of peas and sweet peas.

The word "lucerne" is used in preference to "alfalfa", as it is the common name for *Medicago sativa* in this country.

Natural source of virus:

(*a*) **Lucerne mosaic virus—type.** (TYPE*) *Medicago sativa.* Some leaves had a chlorotic network, spotting or streaking, while others had dark green blisters and were severely puckered.

(*b*) **Lucerne mosaic virus—necrotic strain.** (NECR. STR.) *M. sativa.* The leaves were diffusely mottled and slightly malformed.

(*c*) **Lucerne mosaic virus—Glycine strain.** (GLYC. STR.) *Glycine javanica.* Most leaves had irregular, vivid yellow markings. There was no malformation. See Fig. 5A.

Physical properties:
Thermal inactivation point (all 3) 62–64°C.
Longevity *in vitro.* TYPE AND NECR. STR. 2–4 days.
GLYC. STR. 6–8 days.
Dilution end point (all 3) 1:3000–1:5000.

Transmission:
All three are mechanically sap transmissible.
TYPE AND NECR. STR. *Aphis craccivora.*
Aphis fabae.
GLYC. STR. Results inconclusive.

HOST RANGES.

	TYPE	NECR. STR.	GLYC. STR.
Arachis hypogaea L.	+	+	
Crotalaria juncea L.	+	+	+
C. spectabilis Roth.			+
Dolichos lablab L.	+		+
Glycine javanica L.	−		+
G. max (L.) Merr.	+	−	+
Lathyrus odoratus L.			+
Lupinus albus L.	+	+	+
L. luteus L.	+	+	+
L. mutabilis Sweet.			+
Medicago lupulina L.	+		+
M. sativa L.	+	+	+
Melilotus officinalis Willd.	+	−	+
Phaseolus acutifolius Gray. var. *latifolius* Freem.	+	+	+

*Abbreviations to be used in the text.

	TYPE	NECR. STR.	GLYC. STR.
P. lunatus L.	+		+
P. mungo L.	+		+
P. vulgaris L.	+	+	+
Pisum sativum L.	+	+	+
Trifolium hybridum L.	+		+
T. incarnatum L.	+	+	+
T. pratense L.	+	−	+
T. repens L.	+	+	+
Vicia faba L.	+	+	+
Vigna sesquipedalis (L.) Wight	+	+	+
V. unguiculata (L.) Walp.	+	+	+
Voandzeia subterranea Thouars.		+	+
Nicotiana glutinosa L.	+	+	−
N. tabacum L.	+	+	−
Solanum capsicum L.	+	+	−

Reaction of susceptible species

Arachis hypogaea.

Local. No reaction.
Systemic. Type. A dark green mottle develops.
Necr. Str. There is an irregular chlorotic streak mottle and occasional patterns.
Glyc. Str. Not tested.

Crotalaria juncea.

Local. Necrotic specks develop with all three. Fig. 4B.
Systemic. Type. The growing point curves to one side and the young leaves have a chlorotic network. Later formed leaves develop dark green blisters, and are malformed or even stringlike.
Necr. Str. Most leaves are mottled and elongated, with wavy margins. Later, necrotic specks develop.
Glyc. Str. The leaves show a chlorotic network and then a mottle. The chlorotic areas extend across the leaf, thereby constricting the lamina.

Crotalaria spectabilis. Only the Glyc. Str. was tested.

Local. No reaction.
Systemic. A chlorotic speckling develops.

Dolichos lablab.

Local. Type. Small necrotic specks develop.
Glyc. Str. There is a veinal necrosis and collapse.
Systemic. Type. Some leaves develop a chlorotic spotting.
Glyc. Str. A vein clearing of the young leaves, is followed by yellow vein flecks on later formed leaves. The plant is stunted.

Glycine javanica.

Local. Glyc. Str. Small necrotic specks and veins develop in two days.

Systemic. GLYC. STR. In three weeks the young leaves show a vein-clearing. Later formed leaves have irregular yellow areas or concentric patterns. The symptoms in the glasshouse are not as vivid as those in the field.

Glycine max.

Local. TYPE. No reaction.
GLYC. STR. There are necrotic specks, rings and veins.
Systemic. TYPE. There are chlorotic spots and later a mottle.
GLYC. STR. In three weeks the young leaves develop a chlorotic network or star flecks. Later formed leaves have vivid yellow areas, Fig. 4F and the plant is stunted.

Lathyrus odoratus. Only the GLYC. STR. was tested.

Local. No reaction.
Systemic. A chlorotic mottle develops.

Lupinus albus.

Local. TYPE. Necrotic specks develop in 5–6 days.
NECR. AND GLYC. STR. There are necrotic specks with chlorotic haloes. The necrosis spreads and the leaves absciss. Fig. 4G.
Systemic. TYPE AND NECR. STR. The leaves remain folded, and they have wavy margins. There is a mottle, and fine necrotic speckling on most leaves. The plant is rosetted.
GLYC. STR. As above, but no necrosis. In addition, the leaves are malformed and almost stringlike and there are dark green blisters.

L. luteus.

Local. TYPE AND NECR. STR. The leaves collapse after necrosis.
GLYC. STR. No reaction.
Systemic. TYPE. The leaves have broad dark green veinbands, and the tips are twisted.
NECR. STR. The leaves are mottled and have necrotic specks. They remain small and the plant is rosetted.
GLYC. STR. The young leaves develop chlorotic spots. Later formed ones have irregular dark green areas or blisters. They are also malformed or stringlike, and the plant is stunted.

L. mutabilis. Only the GLYC. STR. was tested.

Local. No reaction.
Systemic. The leaves are chlorotic with dark green marginal blisters. They are severely rolled.

Medicago lupulina.

Local. No reaction with the TYPE AND GLYC. STR.
Systemic. TYPE. Most leaves are mottled and puckered.
GLYC. STR. There is a diffuse chlorotic streaking.

M. sativa.

Local. TYPE. Necrotic specks develop in 5–6 days.
NECR. AND GLYC. STR. No reaction.
Systemic. TYPE. The young leaves develop chlorotic spots and later ones are mottled and slightly crinkled.
NECR. STR. The young leaves have chlorotic, almost white spots, which may become necrotic. On later formed leaves there are irregular yellow areas which cause a malformation. The old leaves have chlorotic blotches.

GLYC. STR. Only a diffuse mottle develops.

Melilotus officinalis.

Local. GLYC. STR. Chlorotic blotches develop.
Systemic. GLYC. STR. The young leaves have chlorotic spots or streaks along the veins, which cause a distortion. Later leaves are small, crinkled and rolled, with irregular chlorotic areas. The plant is stunted.
This plant is a symptomless carrier for the TYPE virus.

Phaseolus acutifolius.

Local. TYPE. There are chlorotic spots and rings.
NECR. STR. There are many necrotic lesions which fuse to give a " scorch " effect.
GLYC. STR. No reaction.
Systemic. With all three, there is a veinclearing followed by a mottle. With the TYPE virus there are also dark green veinbands.

P. lunatus.

Local. TYPE. Chlorotic spots develop in 4–5 days.
GLYC. STR. There are large chlorotic blotches.
Systemic. Only with the GLYC. STR. are there chlorotic vein flecks on the older leaves.

P. mungo.

Local. TYPE. No reaction.
GLYC. STR. The veins become necrotic.
Systemic. TYPE. The young leaves develop chlorotic spots with necrotic centres.
GLYC. STR. There are vivid yellow vein flecks.

P. vulgaris var. Canadian Wonder.

Local. TYPE. There are necrotic rings with almost white centres. Fig. 3A.
NECR. STR. The lesions are similar, but they have irregular outlines. Fig. 3B.
GLYC. STR. There are necrotic lesions and considerable veinal necrosis. Fig. 3C.
Systemic. TYPE AND GLYC. STR. No reaction.
NECR. STR. Isolated necrotic lesions develop along the veins of the trifoliate leaves. (These lesions are of the same type as occur on the inoculated leaves.) They result in the uneven growth of the laminae. Fig. 3D.

var. Haricot.

Local. The necrotic lesions are similar to those on Canadian Wonder; but large areas of these leaves become chlorotic, and the leaves drop.
Systemic. NECR. STR. There is often a severe veinal necrosis which results in the collapse of the plant.

Pisum sativum.

Local. TYPE AND GLYC. STR. No reaction.
NECR. STR. There are necrotic lesions in 5–6 days.
Systemic. TYPE. After a vein clearing of the young leaves the next ones develop chlorotic spots. Older leaves have a chlorotic vein etching.
NECR. STR. No reaction.
GLYC. STR. The leaves are mottled and malformed, and they remain folded. The tendrils are abnormally curled.

Trifolium hybridum.

Local. GLYC. STR. No reaction.
Systemic. GLYC. STR. There are chlorotic streaks and rings, and on later formed leaves, a general chlorosis. As the leaves mature, necrosis sets in, in the chlorosis.
This plant is a symptomless carrier of the TYPE virus.

T. incarnatum.

Local. TYPE. The leaves become chlorotic leaving dark green rings with central necrotic specks.
NECR. AND GLYC. STR. No reaction.
Systemic. With all three there is a chlorotic network followed by a mosaic, and the leaves are crinkled.
TYPE. In addition, the plants are severely stunted and rosetted. Fig. 4E.
GLYC. STR. There are well-defined dark green veinbands on most leaves. Fig. 4D.

T. pratense.

Local. TYPE AND GLYC. STR. Necrotic specks develop in 5–6 days.
Systemic. TYPE. Some plants have a chlorotic mottle, but with others, the virus is latent.
GLYC. STR. The virus is latent but can be recovered.

T. repens.

Local. TYPE. No reaction.
Systemic. TYPE. Chlorotic streaks develop.
This plant is a symptomless carrier for both the NECR. and GLYC. strains.

Vicia faba.

Local. With all three there are red necrotic lesions which may fuse with closely adjacent ones. Fig. 4A.
The leaves become flaccid and absciss.
Systemic. TYPE. No reaction.
NECR. STR. After an initial vein-clearing there may be a lethal necrosis.
GLYC. STR. A diffuse chlorotic mottle develops.

Vigna sesquipedalis.

Local. TYPE. Chlorotic spots develop.
NECR. AND GLYC. STR. There are necrotic specks.
Systemic. TYPE AND NECR. STR. After a vein clearing there is a chlorotic speck mottle.
GLYC. STR. No reaction.

V. unguiculata.

Local. TYPE. There are small necrotic lesions. Fig. 4C.
NECR. AND GLYC. STR. In addition, the rest of the leaves become chlorotic, and they soon drop.
Systemic. TYPE AND GLYC. STR. There is a diffuse mottle.
NECR. STR. Chlorotic spots and necrotic specks develop on the young leaves. On the older ones there are necrotic rings, and the leaves absciss.

Voandzeia subterranea.

Local. NECR. AND GLYC. STR. No reaction.

Systemic. NECR. STR. There are chlorotic spots and later a mottle.
GLYC. STR. The leaves are small and puckered, and they are mottled with dark green veinbands and blisters.

Nicotiana glutinosa.

Local. TYPE AND NECR. STR. There are small necrotic rings with almost white centres. Fig. 5B.
Systemic. TYPE AND NECR. STR. A chlorotic spot mottle develops.

N. tabacum.

Local. TYPE. Chlorotic spots develop in six days.
NECR. STR. There are irregular almost white lesions.
Systemic. TYPE. No reaction.
NECR. STR. There is a diffuse chlorotic spotting.

Solanum capsicum.

Local. TYPE. There are chlorotic spots in six days.
NECR. STR. Necrotic lesions develop.
Systemic. TYPE. The leaves are mottled and malformed or cupped.
NECR. STR. There are necrotic rings or irregular patterns which result in a malformation of the leaf.

IDENTIFICATION.

(*a*) TYPE.—On the basis of host range (including families other than *Leguminosae*), symptoms and physical properties, this virus is classified as lucerne (alfalfa) mosaic virus. Weimer (22, 23).

(*b*) NECROTIC STRAIN.—This virus results in both local and systemic necrosis on bean, and it is therefore firstly compared with others causing a similar symptom.

(i) On some varieties of bean, both the bean Southern mosaic virus, Zaumeyer and Harter (26) and the bean pod mottle virus, Zaumeyer and Thomas (27) cause a local and systemic necrosis. However, both have very restricted host ranges, and the physical properties values differ considerably from those for this virus. Further the pod mottle virus causes a far more severe necrosis on bean.

(ii) The pea New Zealand streak virus, Chamberlain (3) differs in the type of necrosis on bean, pea and lupin, and causes only local lesions on the *Trifolium* species. The physical properties also differ.

(iii) There are several other viruses and strains of lucerne mosaic virus which result in both local and systemic necrosis on bean, but the differences in the type of necrosis and symptoms on other hosts are too great for closer comparisons to be made.

(iv) There is apparently a relationship with the lucerne (alfalfa) mosaic virus group, as the symptoms on many hosts and the physical properties are very similar.

However, this virus cannot be wholly identified with any previously described strain, and it is therefore named lucerne mosaic virus, NECROTIC strain.

(*c*) GLYCINE STRAIN.—There are many similarities between this virus and those in the lucerne mosaic virus group, in respect of symptom expression on several hosts and physical property values.

However, it differs from them in being non-infectious to the solanaceous plants, and the reaction of broad bean, soybean and pea etc. is different. Moreover, many species show a vivid yellow mottle instead of the usual chlorosis.

Relationship with the lucerne mosaic virus is probable and it is named the GLYCINE strain.

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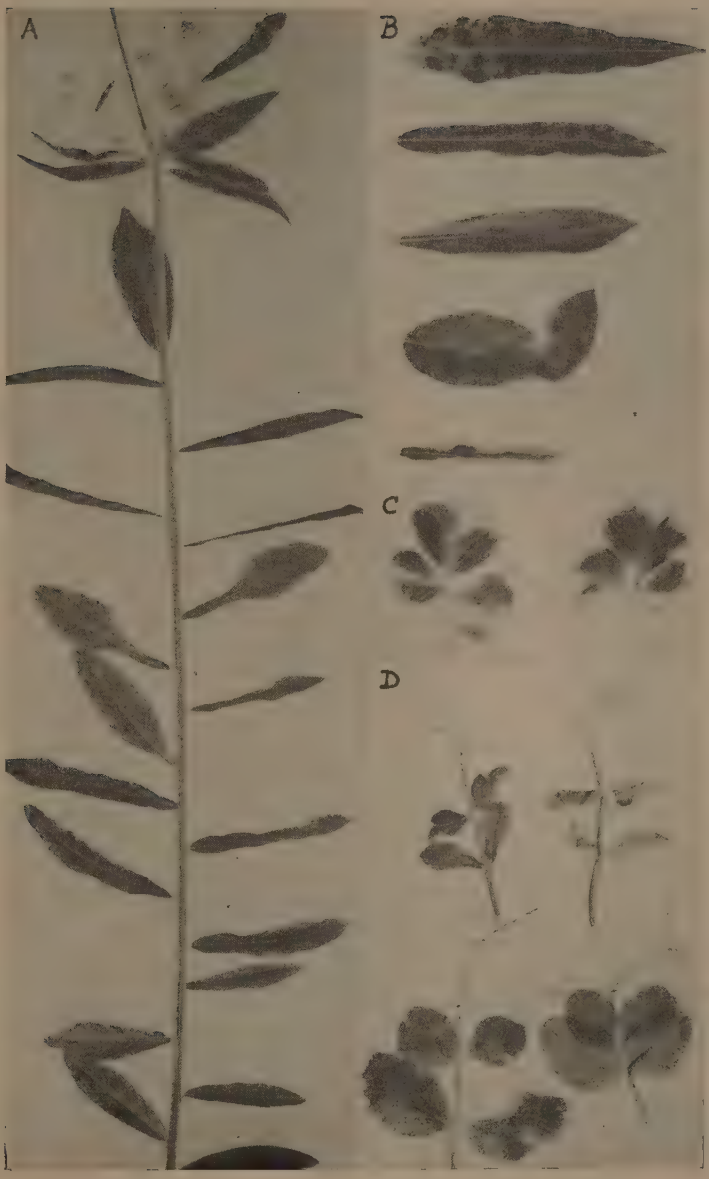

FIG. 1.—ALSIKE CLOVER MOSAIC VIRUS 1.
A. *Crotalaria juncea*—natural infection. B. *C. juncea*—artificial infection. C. *Medicago lupulina*. D. *Pisum sativum*.

FIG. 2.—WHITE CLOVER MOSAIC VIRUS.
A. *Vicia faba.* B. *Phaseolus vulgaris.* C. *Crotalaria spectabilis.*

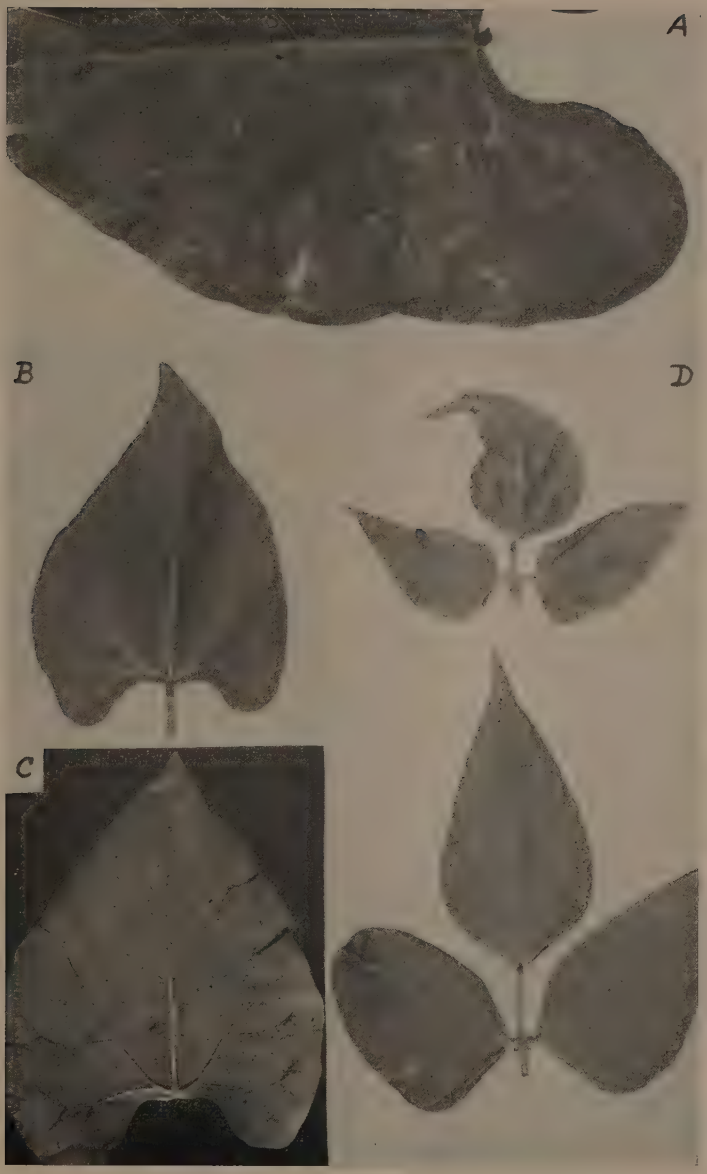

FIG. 3.—LUCERNE MOSAIC VIRUS STRAINS.
A–D. *Phaseolus vulgaris*—local lesions with A. TYPE virus. B. NECROTIC strain. C. GLYCINE strain. D. Systemic lesions with the NECROTIC strain.

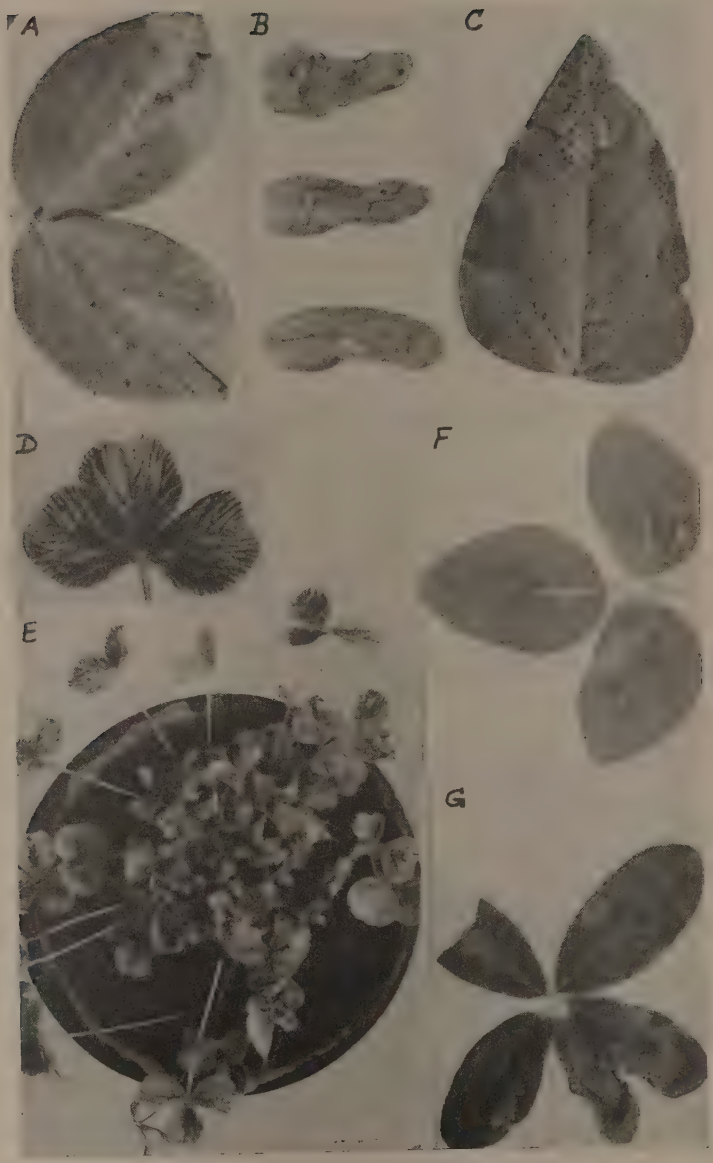

FIG. 4.—LUCERNE MOSAIC VIRUS STRAINS.
A. *Vicia faba*. B. *Crotalaria juncea*. C. *Vigna unguiculata* with the TYPE virus. D–E. *Trifolium incarnatum*. D. GLYCINE strain. E. TYPE virus. F. *Glycine max* with the GLYCINE strain. G. *Lupinus albus* with the NECROTIC or GLYCINE strains.

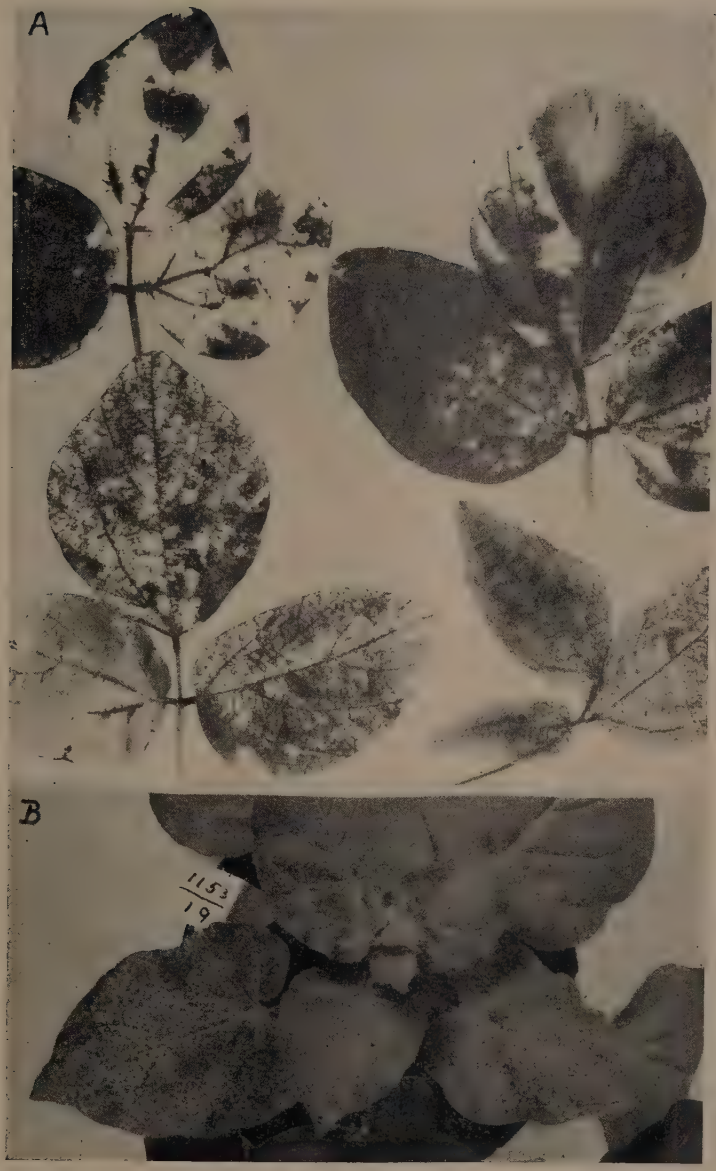

FIG. 5.—LUCERNE MOSAIC VIRUS STRAINS.
A. *Glycine javanica*—natural infection. B. *Nicotiana glutinosa*—local lesions.

The Virus Diseases of Beans

by

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In South Africa several types of bean are cultivated extensively—the runner, bush and haricot types being the most popular. Lima beans are grown on a small scale, but other *Phaseolus* species are rarely found. Apparently, no natural infections occur in the latter group.

The common bean mosaic has already been reported in this country (9); but, although various other disorders were known to be of virus origin, the causal organisms had not been identified.

Of the viroses described here, only bean mosaic and bean yellow mosaic are well known. The others are apparently new viruses or new variants of existing viruses.

An earnest attempt has been made to correlate these diseases with those already described, but with the information available this has not been possible, in all cases.

The differences in symptom expression may be due to the manifestation of known viruses on other varieties of test plants, or to climatic or environmental factors.

Many plant viruses occur in specific localities, and it is also possible that the diseases described here, are limited to this part of the continent.

A detailed account of each virosis is given here, in the hope that this will enable other workers to place them in the known plant virus classification.

Methods and materials

Naturally infected plants were collected from many parts of the Union—notably Pretoria and district, Potchefstroom, the Northern Transvaal, Bethal and district and Stellenbosch.

Some sunnhemp plants were sent from Salisbury, Southern Rhodesia.

The standard test plants used were: *Phaseolus vulgaris* vars. Canadian Wonder and Haricot, *Pisum sativum* var. Greenfeast, *Vicia faba* vars. Aquedulce and Long Pod and *Vigna unguiculata* var. Dr. Saunder's Upright.

Many other legume species were also tested and some solanaceous plants.

Carborundum powder was used to facilitate sap inoculation, and *Aphis craccivora* was the insect vector in limited experiments.

Although some of the isolates used here came from species other than bean (e.g. sunnhemp and soybean) they are placed with the bean viruses. Some caused symptoms on bean, which closely resembled those of the bean isolates; while others resulted in symptoms on bean which were unusual, whereas on the original host, they were insignificant or similar to those caused by other viruses.

1. **BEAN MOSAIC VIRUS** Stewart and Reddick.

Physical properties: Thermal inactivation point 56–58 C.
Longevity *in vitro* 1–2 days.
Dilution end point 1:1000.

Transmission: Mechanical sap inoculation.
Aphis craccivora.
Seed—average of 25·3 per cent for eight varieties.

Host range: *Phaseolus acutifolius* Gray var. *latifolius* Freem., *P. lunatus L.*, *P. vulgaris* L.

Occasionally, plants of the following species would show symptoms. These were checked by sub-inoculation to *Phaseolus vulgaris.*

Pisum sativum L., *Trifolium incarnatum* L., *Vicia faba* L., *Vigna unguiculata* (L.) Walp.

Reaction of susceptible species

Phaseolus acutifolius.

Local. There are chlorotic spots in seven days.

Systemic. The young leaves develop a veinclearing or chlorotic speckling in 12 days, and they are curled. Later leaves are malformed and mottled with dark green blisters.

P. lunatus.

Local. Large chlorotic blotches develop.

Systemic. In three weeks the older leaves show chlorotic vein flecks and the young leaves a chlorotic network.

P. vulgaris var. Canadian Wonder.

Local. Usually there is no local reaction, but occasionally inoculated leaves show large chlorotic blotches some time after the young leaves show systemic symptoms, i.e. about three weeks after inoculation.

Systemic. Rarely do the first trifoliates show any symptoms. If so, there are small chlorotic spots. The second trifoliates curl down from the margins (inverse cupping) and are twisted. They may be slightly puckered and have a diffuse dark green mottle. Later formed leaves are lighter green with dark green puckered veinbands. The tips of these leaflets are long and narrow, and may be malformed. The plant is stunted.

Plants grown from infected seed.

Primary leaves have large dark green areas and the leaf surface may be rugose. There is a slight downward curl of the margins. Fig. 1A.

Trifoliate leaves have varying degrees of inverse cupping and twisting, with broad dark green bands along the midrib of older leaves, and dark green mottling of the younger. Fig. 1B. Later formed leaves may show a clearing of the veins or small chlorotic spots. They may also be malformed and elongated. The plants are generally stunted.

The pods of some varieties show no symptoms, but most are mottled with slight depressions on the surface. The variety Rooikrans, if infected early, has pods with sunken red-brown necrotic areas. The virus is readily transmitted from these lesions.

var. Haricot.

Local. No reaction.

Systemic. The older leaves are inversely cupped, rolled down or twisted. They have raised dark green areas. Later formed leaves have a dark green mottle or veinbanding and may also be curled down, with narrow tips.

Plants grown from infected seed.

The primary leaves have large irregular chlorotic areas, and the surface is uneven. The margins may be curled down. Fig. 2.

The trifoliate leaves have a dark green veinbanding or mottle with raised areas. The young leaves are slightly smaller than normal and may be tly puckered, and/or malformed. These have small chlorotic areas. The plant is stunted. Fig. 2.

The following varieties were also tested and found to be susceptible: Black Wonder, Idaho Refugee (Fig. 1D), Kentucky Wonder (Fig. 1E), Long Tom (Fig 1C), Refugee, S.A. Black and White, Tendergreen and Victor.

A survey was made of some experimental plots and the incidence of natural infection can be seen in Table 1.

Pisum sativum.

Local. No reaction.

Systemic. Some plants developed chlorotic veinbands and a mottle similar to those on the bean. On sub-inoculating to bean, typical symptoms were induced.

Trifolium incarnatum.

Local. No reaction.

Systemic. Some leaves show a diffuse veinbanding and they are rolled.

Vicia faba.

Local. No reaction.

Systemic. Some plants develop chlorotic blotches.

Vigna unguiculata.

Local. No reaction.

Systemic. There may be a chlorotic network followed by a diffuse chlorotic mottle on some varieties.

Natural source of virus: *Phaseolus vulgaris* vars. Canadian Wonder, Kentucky Wonder, Long Tom, Rooikrans and Haricot from Pretoria and district, Nylstroom, Bethal, Rustenburg and Potchefstroom.

IDENTIFICATION.

From the characteristic symptoms on beans and the amount of seed transmission there can be little doubt that this is the common bean mosaic virus. (34, 42).

TABLE 1.—*Incidence of Bean Mosaic Virus in Field Plots*

Roodeplaat—March 1956

(*a*) *Bush Beans.*

Name	*Per cent Natural Infection*	*Name*	*Per cent Natural Infection*
Top Crop	2·0	Breustedts Pallas	75·0
Seminole	4·2	Long Tom	78·3
Refugee	5·0	Wachsbone	91·0
Idaho Refugee	9·5	Brytböna	98·0
Stamslabonen Voorluk	12·5	St. Andreas	98·0
Tendergreen	16·3	Saxa	99·0
Black Wonder	20·2	Burpees Stringless	100·0
Victory	38·0	Grandex	100·0
Streamliner	42·4	Heinrichs Riesen	100·0
Black Wax Pod	50·0	Kaiser Wilhelm	100·0
Wach's Express	57·0	Double White	100·0
Canadian Wonder	57·0	Double Princess	100·0
Nordstern	69·0	Double Holland Princess	100·0
Wach's Breustedts	70·0		

(*b*) *Runner Beans.*

As the runners were tangled on the trellises it was impossible to count the individual plants, so the percentage is only approximate.

Name	*Per cent Natural Infection*	*Name*	*Per cent Natural Infection*
Canfreezer.....	0·0	Gellman Runner.....	100·0
Green Savage.....	5·0	Wach's Goldbone.....	100·0
Everbearing.....	5·0	Mittelfrühe.....	100·0
Kentucky Wonder.....	20·0	Phenomenon.....	100·0
Abundance.....	30·0	Meisterstück.....	100·0
Kapitan Weddingen....	80·0	Lazy Housewife.....	100·0

2.—BEAN MOSAIC VIRUS STRAIN

A second seed-borne virus was found on *Phaseolus vulgaris* var. Canadian Wonder which is used extensively in the insect proof glasshouses. In several batches of seed, about 12 per cent of the seedlings showed symptoms on the primary leaves immediately on unfolding. Conspicuous symptoms later developed on the trifoliate leaves. Fig. 3A.

The effect simulates a heritable abnormality, but positive sub-inoculations to many plant species disprove this possibility.

Physical properties: Thermal inactivation point 60–62°C.
Longevity *in vitro* 2–3 days.
Dilution end point 1:1000–1:5000.

Transmission: Mechanical sap inoculation.
Seed-borne approx. 12 per cent.
Not by *Aphis craccivora.*

Host range: *Arachis hypogaea* L., *Crotalaria juncea* L., *C. spectabilis* Roth., *Dolichos lablab* L., *Glycine max* (L.) Merr., *Lathyrus odoratus* L., *Lupinus albus* L., vars. sweet and bitter, *L. luteus L.*, *L. mutabilis* Sweet., *Medicago lupulina* L., *M. sativa* L., *Melilotus officinalis* Willd., *Phaseolus acutifolius* Gray var. *latifolius* Freem., *P. lunatus* L., *P. mungo* L., *P. vulgaris* L., *Pisum sativum* L., *Trifolium hybridum* L., *T. incarnatum* L., *T. pratense* L., *T. repens* L., *Vicia faba* L., *Vigna sesquipedalis* (L.) Wight., *V. unguiculata* (L.) Walp., *Voandzeia subterranea* Thouars.

Reaction of susceptible species

Arachis hypogaea.

Local. No reaction.

Systemic. After 14 days there are chlorotic spots on the young leaves. Later ones are chlorotic with dark green islands.

Crotalaria juncea.

Local. No reaction.

Systemic. There are chlorotic spots in 10 days and later leaves are mottled and slightly puckered.

C. spectabilis.

Local. No reaction.

Systemic. The young leaves develop a veinclearing, and chlorotic spotting, and flecking. Later leaves are mottled with dark green veinbands, and they are crinkled.

Dolichos lablab.

A symptomless carrier.

Glycine max.

Local. Chlorotic stars develop in five days.

Systemic. The trifoliates have isolated yellow areas which may cause a malformation.

Lathyrus odoratus.

Local. No reaction.

Systemic. A chlorotic spot mottling develops on most leaves.

Lupinus albus var. sweet.

Local. Necrotic specks develop.

Systemic. The young leaves remain folded and have a chlorotic network. Later leaves develop a mosaic and have wavy margins.

L. albus var. bitter.

Local. No reaction.

Systemic. Most leaves are chlorotic with dark green blisters. They are small and curled. The plant is rosetted.

L. luteus.

Local. No reaction.

Systemic. The leaves are mottled, elongated and malformed.

L. mutabilis.

Local. No reaction.

Systemic. The leaves are chlorotic with dark green blisters and necrotic specks. They are small and stringlike and the plant is rosetted.

Medicago lupulina.

Local. No reaction.

Systemic. After an initial spotting, later leaves develop a chlorotic streak mottle.

M. sativa.

Local. No reaction.

Systemic. There may be diffuse chlorotic spots.

Melilotus officinalis.

Local. No reaction.

Systemic. There are chlorotic streaks leaving dark green veinbands. The leaves are slightly puckered.

Phaseolus acutifolius.

Local. Chlorotic spots develop which later become necrotic.

Systemic. There is a chlorotic mottle with dark green blisters which result in an uneven leaf surface.

P. lunatus.

Local. There are chlorotic spots in five days.

Systemic. Most leaves develop chlorotic vein flecks with occasional chlorotic spots.

P. mungo.

Local. Chlorotic spots develop in five days.

Systemic. The young leaves have chlorotic specks.

P. vulgaris var. Canadian Wonder.

Local. There may be isolated chlorotic specks in five days.

Systemic. The young leaves are malformed and curl to one side. They develop an irregular chlorotic speck mottle or vein flecking. Some plants are stunted. Fig. 3B.

var. Haricot.

Local. Small chlorotic spots may develop in five days.

Systemic. The leaves are crinkled, curled and malformed. They develop a chlorotic speck mottle.

Pisum sativum.

Local. No reaction.

Systemic. The young leaves develop a veinclearing and chlorotic spotting in 10 days. Later leaves are mottled, and the plant is rosetted.

Trifolium hybridum.
Local. No reaction.
Systemic. A chlorotic streaking develops.

T. incarnatum.
Local. No reaction.
Systemic. The young leaves show a chlorotic network. Later leaves are chlorotic with dark green areas and also crinkled. The plant is stunted and rosetted.

T. pratense.
Local. No reaction.
Systemic. There is a chlorotic mottle leaving a dark green band along the midrib.

T. repens.
A symptomless carrier.

Vicia faba.
Local. Necrotic lesions develop, and the rest of the leaf becomes chlorotic.
Systemic. No reaction.

Vigna sesquipedalis.
Local. Chlorotic spots develop in five days.
Systemic. After a veinclearing there is a chlorotic spot mottle.

V. unguiculata.
Local. There are chlorotic spots in five days.
Systemic. The young leaves develop a chlorotic network and later ones a chlorotic spotting.

Voandzeia subterranea.
Local. No reaction.
Systemic. After a chlorotic flecking on the young leaves, later ones develop mottle with necrotic specks.

Natural source of virus: *Phaseolus vulgaris.*
Canadian Wonder plants sown in an insect-free glasshouse. The primary leaves had chlorotic, almost white, specks, uniformly scattered over the leaf surface. The trifoliates were crinkled, slightly malformed and often curved to one side. There were areas of chlorotic speck mottling with varying amounts of necrosis in the chlorosis. The plants were severely stunted. Fig. 3A.

IDENTIFICATION.

The symptoms caused by this virus on bean seem to resemble those described by Horsfall (17, 18) in a brief report on the one-sided mosaic—a strain of common bean mosaic virus. However, Zaumeyer (51) working with a disorder similar to that found by Horsfall, attributed the symptom to a heritable abnormality.

When sap from the bean plants used in the experiments described here, was mechanically inoculated to several other legumes, obvious virus symptoms developed. Thus, it was concluded that in this case there was an infective organism involved and not a genetical mutation. Further tests proved that a virus was present.

Bean mosaic virus and its strains are known to be easily seed-transmissible, but there are also reports of the possible seed transmission of the red node virus, Thomas and Graham (46) and bean Southern mosaic virus, Zaumeyer (55). Neither of the latter two viruses show further similarities with the one described here.

The type bean mosaic virus and most of its strains have very restricted host ranges, whereas with this virus, 26 species of *Leguminosae* are susceptible.

Snow (41) reported that a strain from gladiolus, which was 100 per cent seed-borne in beans, was able to infect several other legumes; but not broad bean, red, white or sweet clovers—all of which are hosts to this virus.

As this virus is also seed-transmissible it is provisionally placed with the bean mosaic virus group.

3.—BEAN CHLOROTIC RINGSPOT VIRUSES

Although none of these viruses originated from naturally infected *Phaseolus vulgaris*, the symptom expression on the bean is common to all forms described here. The local reaction consists of unusual, very marked chlorotic ring and line, or ringspot patterns, and the systemic symptom includes a mosaic and dark green blistering accompanied by a necrotic speckling.

The four isolates described here differ from one another on other host plants, but they are provisionally grouped together as strains of one virus, as their reactions on bean are identical.

Natural source of virus and locality:

Strain A.—*Crotalaria juncea.* Pretoria district and Groblersdal.

Strain B.—*Glycine max.* Pretoria and Bethal districts and Potchefstroom.

Strain C.—*Voandzeia subterranea.* Pretoria and district.

Strain D.—*Erythrina caffra.* Pretoria.

PHYSICAL PROPERTIES

	Thermal inactivation point° C.	Longevity *in vitro*—days.	Dilution end point.
Strain A	58–60	2–4	1:5000–1:10000
Strain B	56–58	2–3	1:1000–1:2000
Strain C	56–58	1–2	1:2000–1:5000
Strain D	60–62	1–2	1:1000–1:2000

Transmission: All are transmissible by mechanical sap inoculation. *Aphis craccivora* is not a vector.

Symptoms on naturally infected plants:

Strain A.—*Crotalaria juncea.* Most leaves had a mosaic mottle with dark green veinbands. They were also malformed and rolled. The older leaves had necrotic specks.

Strain B.—*Glycine max.* There were chlorotic specks, spots, veinbands or a mottle on the leaves, and they were slightly malformed and crinkled. The plants were rosetted and stunted.

Strain C.—*Voandzeia subterranea.* The leaves had a chlorotic mottle and the plants were rosetted.

Strain D.—*Erythrina caffra.* The young leaves were reduced in size and had chlorotic spots. Older leaves showed a chlorotic, almost yellow, mottle.

Host ranges

Host Plant.	Strains.			
	A	B	C	D
Arachis hypogaea L.		+	+	
Crotalaria juncea L.	+	+	–	–
C. spectabilis Roth	–	+	–	–
Dolichos lablab L.	+	–	–	–
Glycine javanica L.	+			–
G. max (L.) Merr.	+	–	–	–
Lathyrus odoratus L.	+		–	–
Lupinus albus L.	+	+	–	–
L. luteus L.	+	+	–	–
L. mutabilis Sweet	+	–		–
Medicago lupulina L.	+		–	–
Melilotus officinalis Willd.	–	–	–	–
Phaseolus acutifolius Gray var. *latifolius* Freem.	+	–	–	–
P. lunatus L.	–	–	–	–
P. mungo L.	–	–	–	+
P. vulgaris L.	–	–	–	+
Pisum sativum L.	–	–	–	+
Trifolium fragiferum L.				–
T. hybridum L.	+	+	–	+
T. incarnatum L.	+	+	–	+
T. pratense L.	+	–	–	+
T. repens L.	+			+
Vicia faba L.	+	–		+
Vigna sesquipedalis (L.) Wight	+	–	–	+
V. unguiculata (L.) Walp.	+	–		+
Voandzeia subterranea Thouars	+	–	–	+

Reaction of susceptible species

Not all host plants were inoculated with all four strains, but available results are tabulated below. The letters A–D indicate the strains used.

Arachis hypogaea. B.C.

Local. B.C. No reaction.

Systemic. B.C. The leaves are chlorotic with dark green islands or veinbands

Crotalaria juncea. A–D.

Local. B. There are chlorotic spots in 10 days.

C.D. Necrotic spots or rings develop.

A. A combination of the above, viz., chlorotic spots which later become necrotic.

Systemic. A. After a chlorotic spotting of the young leaves later ones are mottled with dark green blisters. They are also malformed and almost stringlike. The old leaves have necrotic specks. The plant is stunted.

C. There is less malformation than with A but more necrosis—some plants may collapse.

B. D. There is a veinclearing and chlorotic spotting followed by a mottle with dark green veinbands or concentric chlorotic patterns. Fig. 5A. With D the leaves have wavy margins and may be slightly malformed.

C. spectabilis. A–D.

Local. A. D. No reaction.

B. C. There are isolated necrotic lesions.

Systemic. All show a veinclearing followed by a mottle with dark green islands, veinbands or blisters. Fig. 5B. With A–C the leaves are also crinkled and rolled; and the plant is rosetted with A.

Dolichos lablab. A. C. D.

A symptomless carrier for the three strains.

Glycine javanica. A.

Local. There are chlorotic spots in six days.

Systemic. A diffuse chlorotic spotting develops.

G. max. A–D.

Local. C. No reaction.

A. B. There are chlorotic specks or ring and line patterns.

D. A slight veinal necrosis develops.

Systemic. C. D. The leaves have chlorotic patterns and irregular dark green areas. They are also crinkled. Fig. 5H.

A. B. In addition there are necrotic specks, Fig. 5I, and with A the plant is stunted and rosetted.

Lathyrus odoratus. A. C. D.

Local. None show a reaction.

Systemic. A. D. The leaves are mottled with dark green veinbands, and rolled or cupped.

C. There are chlorotic streaks along the veins and the leaves are malformed.

Lupinus albus. A–D.

Local. C. No reaction.

D. There are first chlorotic spots, but later the leaves are uniformly chlorotic.

A. There are chlorotic spots which later become necrotic and the leaves drop.

B. The chlorotic spots have a necrotic speck in the centre.

Systemic. D. The leaves develop a mosaic and the plant is slightly stunted.

B. C. As well as a mosaic, the leaves have dark green blisters and they are small and malformed. With B many leaves drop, leaving an almost bare stem and petioles.

A. In addition there are necrotic specks on the leaves and the plant is severely stunted.

L. luteus. A–D.

Local. C. D. No reaction.

A. B. Chlorotic spots develop.

Systemic. C. D. The young leaves remain folded and have wavy margins. Later formed leaves are mottled, and malformed or elongated. The plant is stunted.

A. B. In addition there are necrotic specks.

L. mutabilis. A. B. D.

Local. No reaction.

Systemic. With all three strains the leaves are mottled, malformed and reduced in size. The plant is rosetted.

Medicago lupulina. A. C. D.

Local. No reaction.

Systemic. A. C. After a veinclearing there is a mottle with chlorotic streaks. The leaves are crinkled.

D. A symptomless carrier.

Melilotus officinalis. A–D.

Local. A–C. No reaction.

D. There are chlorotic spots.

Systemic. B–D. The leaves are mottled and crinkled.

A. There is a chlorotic ring spotting on the young leaves, and streaking on later ones, which are also small and malformed. Fig. 5F.

Phaseolus acutifolius. A–D.

Local. A. Chlorotic spots and veins develop.

B. C. D. There are necrotic lesions and veins plus chlorotic spots. These leaves usually collapse.

With C. there is also a marked epinasty.

Systemic. A. The young leaves curl back and have chlorotic veins and spots. Later leaves have an almost white speck mottling.

C. In addition to the above mottle there are dark green blisters. The pods are also mottled.

B. C. D. The young leaves curl back and develop a chlorotic network or patterns which become necrotic. Fig. 5D. This results in a collapse of plants inoculated with D. Should secondary shoots develop they have malformed, mottled leaves.

P. lunatus. A–D.

Local. D. No reaction.

B. Large chlorotic blotches develop.

A. C. There are chlorotic spots or ringspots which with C. become necrotic later. Fig. 5E.

Systemic. With all strains there is a chlorotic network or vein flecking. With A and D this is accompanied by a necrosis in the chlorosis.

P. mungo. A–D.

Local. C. No reaction.

D. Chlorotic spots develop.

A. B. There are necrotic spots and veins.

Systemic. A–C. There is a chlorotic spotting.

D. Only a diffuse mottle develops.

P. vulgaris. A–D.

(*a*) var. Canadian Wonder.

Local. All induce chlorotic ringspots, ring and line patterns or a vein etching. Fig. 4A.

Systemic. The young leaves develop a veinclearing and chlorotic spots, Fig. 4D., and the leaves curl down. On some newly formed leaves there are yellow specks or distinct rings Fig. 4E., but later there is a mottle. The leaves are crinkled and have many small necrotic specks. Fig. 4C.

With D. the pods are mottled and with C. they are malformed and have necrotic rings. Fig. 5G.

(*b*) var. Haricot.

Local. All strains result in chlorotic ringspots, or ring and line patterns. Fig. 4B.

Systemic. After an initial veinclearing and chlorotic spotting the next formed leaves are mottled with dark green blisters, and they are malformed. The plants are rosetted.

With A. there is also a necrotic speckling which may cause a collapse of the plant.

(*c*) vars. Black Wonder, S.A. Black and White, Long Tom and Victor develop symptoms similar to Canadian Wonder.

(*d*) vars. Tendergreen and Idaho Refugee do not produce a distinct local reaction, but the systemic symptoms are similar to those on Canadian Wonder.

Pisum sativum. A–D.

Local. B. C. No reaction.

A. Chlorotic specks develop and the leaves drop.

Systemic. B. C. Some leaves are mottled, while others have chlorotic areas which lead to a constriction of the laminae. The plants are rosetted and stunted.

A. The young leaves remain folded and have a chlorotic network and spotting. Later formed leaves develop a mosaic, while the old leaves have a white vein etching. The plant is rosetted and the tendrils are abnormally curled.

D. A symptomless carrier.

Trifolium hybridum. A. B. D.

Local. No reaction.

Systemic. All three strains cause chlorotic spots or streaks and occasionally a mottle.

A. can be latent on this host.

T. incarnatum. A–D.

Local. A. B. C. No reaction.

D. There is a chlorotic vein etching and spotting.

Systemic. A. B. C. After a veinclearing there is a mottle with dark green veinbands, and the leaves are crinkled.

D. In addition the older leaves develop chlorotic spots with necrotic rings.

T. pratense. A–D.

Local. No reaction.

Systemic. B. C. D. There are chlorotic spots, streaks or blotches. With C there are also yellow concentric patterns on the older leaves.

A. A symptomless carrier.

T. repens. A. D.

A symptomless carrier with both strains.

Vicia faba. A–D.

Local. D. No reaction.

A. Necrotic lesions develop.

B. There are purple necrotic rings and the remaining tissue becomes yellow.

Systemic. D. Diffuse chlorotic spots develop.

A. There is a chlorotic spotting with a necrotic network.

B. C. No symptoms but the virus can be recovered.

Vigna sesquipedalis. A–D.

Local. D. No reaction.

A. There are chlorotic spots but later the whole leaf becomes chlorotic.

B. There are necrotic lesions and the rest of the leaf becomes chlorotic. They soon absciss.

C. In addition to the symptoms with B there is a marked epinasty.

Systemic. All induce a veinclearing, chlorotic spotting and mottle. B. may cause a stunting of the plants.

V. unguiculata. A–D.

Local. D. No reaction.

A. After a chlorotic spotting the leaves become flaccid.

B. There are necrotic lesions and the remaining leaf tissue becomes yellow. The leaves soon drop.

C. There is a marked epinasty as well.

Systemic. B. C. D. Chlorotic spots develop and later a mottle.

A. In addition there are dark green blisters with the mottle, and later a necrotic sheen. The leaves are malformed and there may be necrotic stem streaks.

Voandzeia subterranea. A–D.

Local. Only with C are there chlorotic blotches.

Systemic. With all strains there may be a veinclearing, mottle and crinkle. Fig. 5C. Some plants with A and D are symptomless carriers.

IDENTIFICATION.

The characteristic feature of this group of viruses is the well-defined chlorotic ring and line or ringspot reaction on the inoculated leaves of bean. Similar symptoms on some varieties of bean are described by Cheo and Zaumeyer (8) with their strain of tobacco ringspot virus from bean, and with the green strain of tobacco ringspot.

However, none of the four isolates recorded here can be fully identified with either of these strains. There may be similarities in symptom expression on several hosts,

e.g. on *Glycine max* the D isolate resembles the bean strain of Cheo and Zaumeyer, and on white lupin the A isolate is similar to the green strain, but on other plants there are considerable differences.

Further, *Dolichos lablab* which is used as a differential host by Cheo and Zaumeyer when comparing four strains of tobacco ringspot virus, is a symptomless carrier for three of the isolates described here, viz. A. C. D. and is not susceptible to the fourth.

On cowpea, the bean strain induces a systemic necrosis, which does not occur with any of these strains; and on broad bean it causes systemic necrotic rings which are not present with any of these isolates.

The type tobacco ringspot virus on bean usually induces local necrotic spots, rings or veins followed by systemic necrosis and collapse, Pierce (29) and Price (32). The effect of the viruses described here is mainly chlorotic with only necrotic specks on the trifoliates.

Stubbs (43) described the symptoms of the type virus on peas, which is also necrotic, whereas with these strains it is only chlorotic.

In addition, the host ranges differ considerably.

Although there can be little doubt that the viruses recorded here are related to the tobacco ringspot group, there is no complete correlation with any of the strains previously described. They are therefore reported as additional strains and named bean chlorotic ringspot viruses A, B, C and D.

4.—BEAN LOCAL CHLOROSIS VIRUSES

The characteristic feature of the viruses in this group is the local reaction on the bean, viz. a distinct chlorotic spotting. This reaction occurred with isolates from several plant species. In other details these seven isolates differ from one another. They are therefore not considered to be one virus, but strains of the virus linked by their common local reaction on the bean. (Only strains F and G differ slightly in the systemic reaction on bean.)

Natural source of virus and locality:

Strain A.—*Medicago denticulata.* Stellenbosch.

B.—*Lathyrus odoratus.* Pretoria and district.

C.—*Phaseolus vulgaris.* Rustenburg.

D.—*Crotalaria juncea.* Salisbury.

E.—*Glycine max.* Pretoria, Nylstroom, Potchefstroom.

F.—*Phaseolus vulgaris.* Pretoria district.

G.—*Trifolium incarnatum.* Stellenbosch.

PHYSICAL PROPERTIES

Virus.	Thermal inactivation point °C.	Longevity *in vitro*—days.	Dilution end point.
Strain A	60–62	2–3	1:2,000–1:5,000
Strain B	58–60	2–3	1:1,000–1:2,000
Strain C	58–60	1–2	1:1,000–1:2,000
Strain D	62–65	1–2	1:2,000–1:5,000
Strain E	56–58	1–2	1:1,000–1:2,000
Strain F	60–62	3–4	1:2,000–1:5,000
Strain G	56–58	1–2	1:2,000–1:5,000

Transmission: All are transmissible both by mechanical sap inoculation and by *Aphis craccivora*.

Symptoms on naturally infected plants (i.e. source of virus).

Strain A.—*Medicago denticulata*. The leaves showed varying degrees of chlorosis—spots, streaks, mottle and mosaic. They were small and crinkled and the plants were stunted. The incidence of infection was high.

Strain B.—*Lathyrus odoratus*. The leaves had chlorotic streaks or veinbands and they were small and puckered.

Strain C.—*Phaseolus vulgaris* var. Black Wonder. Most leaves were puckered and had small chlorotic specks. The plants were slightly stunted.

Strain D.—*Crotalaria juncea*. Some leaves had chlorotic spots, but most showed a mosaic, with dark green veinbands. They were also slightly malformed and rosetted; and the plants were stunted.

Strain E.—*Glycine max*. The leaves were mottled and puckered, and the plants were slightly stunted with a proliferation of the lateral shoots.

Strain F.—*Phaseolus vulgaris* (*a*) var. Long Tom. The leaves were mottled and severely curled and malformed. There were occasional necrotic stem streaks, and the pods had marked necrotic lesions. (*b*) var. Haricot. The young leaves had a chlorotic network and were curled. Older ones were crinkled and mottled with dark green blisters.

Strain G.—*Trifolium incarnatum*. The leaves showed irregular chlorosis and they were small, crinkled and malformed. The plants were severely stunted.

HOST RANGES.

Host Plant.	Strains.						
	A	B	C	D	E	F	G
Arachis hypogaea L.	+	−			−		−
Crotalaria juncea L.	+	−	−	+		+	−
C. spectabilis Roth.	−	+	+	+		+	−
Dolichos lablab L.	+		+	−	−		
Glycine javanica L.	−		+	−		−	+
G. max (L.) Merr.		−	+	−	−	−	−
Lathyrus odoratus L.	+	−	+	+		+	−
Lupinus albus L.	+	+	+	+	+	+	−
L. luteus L.	+	−	+	−	+	+	−
L. mutabilis Sweet.	+		+	−			−
Medicago denticulata L.	+						
M. lupulina L.	+		+	−		+	−
Melilotus officinalis Willd.	+		+	+		−	−
Phaseolus acutifolius Gray var. *latifolius* Freem.	+		−	+		+	−
P. lunatus L.	+	−	+	+	−	−	−
P. mungo L.	+	−	+	+	+	−	−
P. vulgaris L.	+	+	+	+	+	−	−
Pisum sativum L.	+	+	+		−	−	−
Trifolium fragiferum L.	−		−			+	
T. hybridum L.	+	+	+	+	−	+	−
T. incarnatum L.	+	+	+	+	−	+	+
T. pratense L.	+	−		+		−	+
T. repens L.	−	−		−		+	−
Vicia faba L.	+	+	+	+	+	+	−
Vigna sesquipedalis (L.) Wight.	+			+	+	+	−
V. unguiculata (L.) Walp.	+	+	+	+	+	+	−
Voandzeia subterranea Thouars.	+	−	+	+		+	+

Reaction of susceptible species

Not all strains were tested on every host plant, but the available results are compared below. The letters, A–G indicate the strains.

Arachis hypogaea. A. E. G.

Local. No reaction.

Systemic. A. The young leaves develop a mottle with a dark green midrib.

E. Chlorotic spots develop on the young leaves in 14 days. Later leaves are chlorotic with dark green islands.

G. There is a chlorotic mottle on most leaves.

Crotalaria juncea. A. C. D. F. G.

Local. A. C. G. No reaction.

D. Chlorotic spots develop in eight days.

F. In seven days large necrotic lesions develop which fuse later to give a " scorch " effect.

Systemic. A. G. After a veinclearing of the young leaves, the next formed are mottled with dark green blisters. They are also crinkled and curled and the plant is stunted.

C. In addition to the above there is a severe malformation and some leaves are almost stringlike. Fig. 6A.

D. F. Similar to C. with necrotic specks. With F, also a vascular necrosis which results in the death of the plant.

Crotalaria spectabilis. A. B. C. D. F. G.

Local. Only with D are there small chlorotic spots.

Systemic. A. D. The young leaves develop a chlorotic network and speckling. The next leaves are crinkled with wavy margins, and are chlorotic with irregular dark green islands.

C. F. After a veinclearing the leaves develop dark green veinbands.

B. The new leaves have conspicuous white streaks which result in a malformation. (See report on sweet pea virus diseases for photograph.)

G. There is a mild speck mottling.

Dolichos lablab.

A symptomless carrier for A. C. D.

Glycine javanica. A. C. D. F. G.

F. G. Symptomless carriers.

Local. A. D. Chlorotic spots develop in 4–5 days.

C. No reaction.

Systemic. A. D. A diffuse mottle develops.

C. A chlorotic spotting is followed by chlorotic streaks.

Glycine max. B–G.

Local. B. C. D. No reaction.

G. There is a general chlorosis.

E. F. Chlorotic stars, rings and spots develop. With F. there are also necrotic specks.

Systemic. B. C. Only a diffuse mottle develops.

D. After a chlorotic spotting, there is a mottle of the leaves which are crinkled.

G. There may be chlorotic spots with necrotic rings on the older leaves, while the younger ones are mottled.

E. F. There is first a veinclearing, then chlorotic spotting and a mottle. Later, necrotic specks develop. The leaves are crinkled and the plants are stunted.

Lathyrus odoratus. A. B. C. D. F. G.

Local. No reaction.

Systemic. C. There is only a diffuse mottle.

F. The leaves are elongated and rolled and show chlorotic streaks.

A. D. G. The early symptoms are similar to F, but later formed leaves have a mottle with well-defined dark green veinbands.

B. There is a mosaic mottle on most leaves and the stems show necrotic streaks. (See report on the virus diseases of sweet pea.)

Lupinus albus. A–G.

Local. A. B. C. No reaction.

D. F. There are small necrotic specks.

E. After the necrotic specks have developed, the leaves become chlorotic and soon drop.

Systemic. A. After a chlorotic spotting of the young leaves, there are dark green blisters on later formed leaves which are reduced in size. The plant is stunted.

C. E. There is an initial mosaic but later leaves are quite chlorotic. They are small, have wavy margins and remain folded. Many abscis.

B. D. G. In addition to the symptoms for C. E. there are necrotic specks on the leaves; and necrotic stem streaks with D.

Lupinus luteus. A–G.

Local. A. B. C. F. G. No reaction.

D. Chlorotic spots develop.

E. The leaves are chlorotic with necrotic specks and they soon drop.

Systemic. A. B. The leaves are mottled and crinkled and they remain folded.

C. E. G. There is also a malformation of the leaves and the plant is stunted.

D. F. The malformation is severe and the leaves are stringlike with dark green blisters.

With F. there are also necrotic stem streaks.

Lupinus mutabilis. A. C. D. G.

Local. No reaction.

Systemic. A. D. The leaves are chlorotic with dark green blisters, and they are malformed. The plant is rosetted.

C. G. The plants collapse after necrosis.

Medicago lupulina. A. C. D. F. G.

Local. Only with F is there a reaction. Necrotic lesions develop, and fuse, and the leaves collapse.

Systemic. The symptoms are similar for all strains, viz. a chlorotic streak mottle and/or dark green veinbands. With D the leaves are crinkled.

Melilotus officinalis. A. C. D. F. G.

Local. A. C. G. No reaction.

D. F. There are chlorotic spots with dark green rings.

Systemic. C. D. A chlorotic spot mottling develops.

A. In addition the leaves are malformed.

F. G. There are distinct ring and line patterns and the leaves are malformed.

With F there may also be necrotic specks.

Phaseolus acutifolius. A. C. D. E. F. G.

Local. All these strains induce a chlorotic and necrotic reaction—usually chlorotic spots with necrotic veins. C and E also induce necrotic spots and G also causes necrotic rings round the chlorotic spots.

Systemic. A. C. F. After a veinclearing there is a mottle with slight malformation.

D. E. G. In addition there is a necrosis of the veins; or necrotic specks with G.

P. lunatus. A. C. D. E. F. G.

Local. Except for D, these strains induce chlorotic spots or large blotches. D shows no reaction.

Systemic. D. After a veinal necrosis the leaves drop.

The other strains cause a chlorotic vein flecking.

P. mungo. A. C. D. E. F. G.

Local. A. D. There are chlorotic spots.

F. There are necrotic spots.

E. G. There are both chlorotic spots and necrotic specks or veins.

Systemic. A. E. After a veinclearing there are chlorotic spots or irregular areas.

D. F. G. In addition, necrosis sets in, in the chlorosis and the leaves have a necrotic sheen.

C is latent in this plant.

P. vulgaris var. Canadian Wonder. A–G.

Local. All strains cause distinct, vivid chlorotic spots. Fig. 6C. These may fuse with closely adjacent ones, Fig. 6D, but usually they retain their individuality.

Systemic. A–E. After a clearing of the veins there is a chlorotic spotting and then a mottle.

With D and E there are also dark green veinbands.

F. G. In addition the young leaves develop necrotic specks and they are malformed. The pods have sunken dark green areas and they are misshapen.

vars. Black Wonder, Idaho Refugee, Long Tom, S.A. Black and White, Tendergreen and Victor show symptoms similar to those on Canadian Wonder.

var. Haricot may develop local chlorotic specks with strains A. D. E. F., but, on the trifoliate leaves the reaction is the same as that on Canadian Wonder.

Pisum sativum. A–G.

Local. B. C. E. G. No reaction.

A. F. After a veinal necrosis the leaves collapse.

D. There may be chlorotic specks.

Systemic. A. B. F. After a veinclearing and chlorotic spotting there is a mottle on later formed leaves. Necrosis sets in, in the chlorosis, or there are necrotic stem streaks and the plant collapses.

C. G. There is a veinclearing, chlorotic spotting and mottle, and the plants are rosetted.

D. E. In addition to the mottle, the leaves are malformed and small, and the tendrils are abnormally curled. The older leaves have an almost white vein etching.

Trifolium fragiferum. F.

Local. Necrotic spots develop after six days.

Systemic. A diffuse chlorotic (almost white) spotting occurs.

T. hybridum. A–G.

Local. A. C. D. E. G. No reaction.

B. F. There is a chlorotic spotting.

Systemic. A. B. C. G. Chlorotic streaks following the veins develop.

D. F. There is a chlorotic spotting on the young leaves, and on later formed ones there is a vivid yellow streak mosaic. With D the plants are also stunted.

E. A symptomless carrier.

T. incarnatum. A–G.

Local. B. C. E. F. No reaction.

A. D. Chlorotic spots develop in 5–6 days.

G. There are chlorotic spots with necrotic rings and necrotic centres.

Systemic. B. C. E. After a veinclearing there is a mosaic mottle, and slight puckering of the leaves.

D. G. There is a chlorotic network, followed by a chlorotic spotting and later a mosaic. The leaves are crinkled and malformed, and the plant is rosetted and stunted.

F. In addition to the symptoms for D and G, necrosis sets in, in the chlorotic spots.

A. After 10 days the young leaves show a veinclearing. Later formed leaves have a mosaic with dark green veinbands and blisters. They are severely crinkled, with wavy margins. The plant is extremely stunted and rosetted, and may collapse.

T. pratense. A. D. F. G.

Local. A. D. F. G. No reaction.

Systemic. A. In 10 days the veins are chlorotic, and later a mosaic develops. The leaves are crinkled and may be malformed with necrotic areas.

D. F. There is a chlorotic streak mottle, but D may be latent in this host.

G. After a veinclearing there are short dark green veinbands and a dark green midrib. The leaves are crinkled or slightly malformed.

T. repens. F. G.

A symptomless carrier for both strains.

Vicia faba. A–G.

Local. B. C. No reaction.

A. There are chlorotic spots with small necrotic specks in four days.

D. Small necrotic lesions develop.

F. In 4–5 days there are large necrotic lesions which spread and fuse with adjacent ones. As the leaves mature, the background becomes yellow. Fig. 6B.

Systemic. A. B. C. D. There is a chlorotic network and spotting, with a mottle on later formed leaves.

F. Occasionally the local necrosis will spread down the petiole and thence into the stem. This results in the collapse of the plant.

E. G. Symptomless carrier.

Vigna sesquipedalis. A. D. E. F. G.

Local. A. E. F. G. Chlorotic spots develop in 5–6 days.

D. There are first chlorotic ringspots, but later the whole leaf becomes chlorotic.

Systemic. A. No reaction.

D. E. F. G. There are chlorotic spots and later a mottle.

V. unguiculata. A–G.

Local. D. No reaction.

A. B. C. E. G. There are necrotic lesions in 4–5 days.

F. Although there is no necrosis, the leaves become flaccid and absciss.

Systemic. B. No reaction.

A. C. E. F. G. After a veinclearing there are chlorotic specks, and, on later formed leaves, a mottle.

D. The mottle is accompanied by dark green blisters.

Voandzeia subterranea. A. C. D. F. G.

Local. A. C. F. G. No reaction.

D. There are chlorotic spots with necrotic rings in seven days.

Systemic. All induce a chlorotic spotting followed by a mottle. In addition, D causes dark green veinbands.

IDENTIFICATION.

The feature which links these seven strains is the vivid chlorotic spotting on the inoculated leaves of the bean.

A similar symptom has been described by Ainsworth with the " sweet pea streak " virus (1), Zaumeyer with alfalfa yellow mosaic virus (53) and Smith and Markham with a virus from *Ligusticum* (40). Van der Want (50) reports that on the variety Servus, local chlorotic spots are sometimes produced with two strains of bean yellow mosaic virus.

However, although there may be other similarities between these four viruses and some of the strains described here, there is no complete correlation, e.g. strain G resembles alfalfa yellow mosaic in its reaction on bean, pea and broad bean, but on other hosts it differs considerably. Further, the alfalfa yellow mosaic can infect solanaceous plants, whereas the host range of this virus is restricted to the *Leguminosae*.

During a survey of legume virus diseases in England (22) three strains causing this characteristic local reaction on bean were isolated from naturally infected species of *Phaseolus*, *Pisum*, *Vicia*, *Trifolium*, *Medicago*, *Melilotus* and *Lathyrus*. These strains

were designated A. B. and C, and they have also been found in this country on *Phaseolus*, *Lathyrus* and *Medicago* spp. A further four strains have been isolated from other naturally infected host plants, viz. *Crotalaria*, *Glycine*, *Phaseolus* and *Trifolium* spp. and are named bean local chlorosis virus, strains D. E. F. and G.

5. BEAN NECROSIS VIRUS

A virus found on naturally infected *Crotalaria spectabilis* caused extremely severe local and systemic necrosis on bean. A similar reaction on bean developed with isolates from *Dolichos lablab* and *Glycine javanica*, but on some other host plants these isolates differed.

In this account the virus is described as a whole, and the variations are given under the appropriate species.

Physical properties: Thermal inactivation point 65–70°C.
Longevity *in vitro* 6–7 days.
Dilution end point 1:5,000–1:10,000.

Transmission: Mechanical sap inoculation.
Not by *Aphis craccivora*.

Host range: *Arachis hypogaea* L., *Crotalaria juncea* L., *C. spectabilis* Roth., *Dolichos lablab* L., *Glycine javanica* L., *G. max* (L.) Merr., *Lathyrus odoratus* L., *Lupinus albus* L., *L. luteus* L., *L. mutabilis* Sweet., *Medicago lupulina* L., *Melilotus officinalis* Willd., *Phaseolus acutifolius* Gray var. *latifolius* Freem., *P. lunatus* L., *P. mungo* L., *P. vulgaris* L., *Pisum sativum* L., *Trifolium hybridum* L., *T. incarnatum* L., *T. pratense* L., *Vicia faba* L., *Vigna sesquipedalis* (L.) Wight., *V. unguiculata* (L.) Walp., *Voandzeia subterranea* Thouars.

Reaction of susceptible species

Arachis hypogaea.

Local. No reaction.

Systemic. The leaves have chlorotic areas with dark green islands.

Crotalaria juncea.

Local. There are necrotic lesions and the leaves drop.

Systemic. After 12 to 14 days there is a vein clearing of the young leaves, followed by a chlorotic spotting and a mottle mosaic. The leaves are rolled and the plant is stunted.

C. spectabilis.

Local. No reaction.

Systemic. After a veinclearing and spotting of the young leaves, later ones are very chlorotic and rolled and crinkled. The plant is stunted.

Dolichos lablab.

Local. No reaction.

Systemic. The young leaves develop a chlorotic network. The next formed leaves are mottled and slightly crinkled.

Glycine javanica.

Local. There are small necrotic specks and the leaf becomes chlorotic.

Systemic. Chlorotic spots and vein flecks develop on most leaves. On some there are large irregular chlorotic blotches, and the leaves are puckered.

Glycine max.

Local. Small necrotic specks appear in 10 days.

Systemic. The young leaves develop chlorotic veins, spots and flecks. Necrosis develops in the chlorosis of the old leaves, resulting in a malformation. The plant is stunted.

Lathyrus odoratus.

Local. No reaction.

Systemic. Most leaves show a dark green streak mottle and they are rolled downwards.

Lupinus albus.

Local. There are chlorotic spots.

Systemic. In 11 to 12 days the young leaves develop a veinclearing with chlorotic spots. Later leaves are small and malformed with dark green blisters. They remain folded and the margins are irregular. The growing point is rosetted and the plant is stunted. Many older leaves drop.

L. luteus.

Local. Small chlorotic spots may develop.

Systemic. A veinclearing and chlorotic spotting of the young leaves develops in eight to nine days. New leaves remain folded with the tips twisted. They are mottled and small. The plant is stunted.

L. mutabilis.

Local. No reaction.

Systemic. The young leaves curl up, and they are spotted. Later ones are very small and chlorotic. Many drop.

Medicago lupulina.

A symptomless carrier.

Melilotus officinalis.

Local. No reaction.

Systemic. Occasional irregular vivid chlorotic areas and some dark green ringspots develop. Fig. 7B. The virus is recoverable from symptomless leaves.

Phaseolus acutifolius.

Local. There may be necrotic specks.

Systemic. The young leaves curl back and have veins which are chlorotic then necrotic. The plant collapses.

P. lunatus.

Local. Small necrotic lesions appear in four days. These have chlorotic haloes.

Systemic. There are chlorotic vein flecks on most leaves in three weeks. Fig. 7C.

P. mungo.

Local. In five days there are necrotic rings.

Systemic. There is a chlorotic spotting and then a mosaic with a slight distortion.

P. mungo with the B isolate.

A symptomless carrier.

P. vulgaris var. Canadian Wonder.

Local. There is a severe necrosis of the veins and petioles. Fig. 7E.

Systemic. In 12 days the young leaves start to curl round and back, and have a veinclearing. Necrosis sets in, in the veins causing a malformation. These leaves drop and very few more are formed. Fig. 7A. The old leaves have large chlorotic blotches.

var. Haricot.

Local. In seven to eight days the leaves have necrotic veins.

Systemic. This necrosis spreads along the petioles and up the stem. The young leaves show a necrotic sheen and the growing point collapses in 14 to 15 days.

Pisum sativum.

Local. The leaves collapse after a general necrosis.

Systemic. In eight to nine days a veinclearing of the young leaves develops. Later leaves have a mottle or mosaic with necrosis. The growing point is rosetted and the plant is stunted and may collapse.

P. sativum. With the B isolate.

Local. No reaction.

Systemic. Only a chlorotic network of the young leaves develops in 13 days.

Trifolium hybridum.

Local. No reaction.

Systemic. After a chlorotic spotting on the young leaves, the next show alternate streaks. Necrosis sets in, in the chlorosis. Fig. 7D.

The B isolate is latent.

T. incarnatum.

Local. There are necrotic veins on chlorotic leaves.

Systemic. In a week the young leaves show a chlorotic network, and vein flecks. Later leaves have a mosaic with dark green veinbands and they are crinkled. The plant is very stunted and usually collapses.

The B isolate is latent.

T. pratense.

Local. No reaction.

Systemic. There are diffuse dark green veinbands.

Vicia faba.

Local. There are necrotic rings on chlorotic leaves.

Systemic. After 10 days the young leaves show a chlorotic network with small chlorotic spots. Later leaves are mottled.

Vigna sesquipedalis.

Local. No reaction.

Systemic. The young leaves develop chlorotic spots and flecks, and later veinbands.

V. unguiculata.

Local. In five days the leaves show necrotic spots and they drop.

Systemic. Only a diffuse mosaic develops on the young leaves of some varieties. The virus is recoverable from symptomless plants.

Voandzeia subterranea.

A symptomless carrier.

Natural source of virus:

(*a*) *Crotalaria spectabilis.* Potchefstroom, Pretoria and district. There was a chlorotic mottle with dark green veinbands and blisters. On older leaves there was necrosis in the chlorosis, and there were also necrotic stem streaks. The plants were stunted and rosetted.

(*b*) *Dolichos lablab.* Prinshof Experimental Station, Pretoria. The younger leaves had chlorotic spots; and the older ones, a mottle with dark green veinbands and blisters.

(*c*) *Glycine javanica.* An experimental plot adjacent to (*b*). There were irregular chlorotic areas on most leaves, which were also puckered.

IDENTIFICATION.

The dominant feature of this virus is the severe local and systemic necrosis on bean. This type of symptom occurs with many other viruses, with which this one will be compared:—

(*a*) The reaction appears to be very similar to photographs of black root, Jenkins (19, 20) which is the symptom expression of common bean mosaic virus on particular variety lines of bean. However, as Canadian Wonder has been used throughout these experiments, and has shown the more typical reaction of bean mosaic (veinbanding, rolling etc.) that virus is not the causal agent. This is further confirmed by the great differences in host range and physical properties.

(*b*) There are several strains of alfalfa mosaic virus which may result in similar symptoms on some varieties of bean, e.g. the tuber necrosis and potato calico strains of Oswald (26), alfalfa mosaic N of McWhorter (23) and alfalfa yellow mosaic virus of Zaumeyer (53). However, on other hosts the symptoms differ considerably from those caused by this virus, and, with the first three-named strains, the property values differ also.

(*c*) Of the several bean yellow mosaic virus strains, only the X-strain of McWhorter (24) and the severe yellow strain of Thomas and Zaumeyer (49) induce both local and systemic necrosis on some varieties of bean. Nevertheless, the differences in symptom expression on other host plants, host ranges and physical properties are too great for this virus to be identified with either strain.

(*d*) On bean, pea and soybean this virus induced symptoms similar to those caused by the pea streak virus, Chamberlain (7), but on other plants they are dissimilar. Further, the pea streak virus withstands higher temperatures and dilutions and longer ageing than this one.

(*e*) This virus cannot be identified with the bean Southern mosaic, Zaumeyer and Harter (55) as the latter has a very restricted host range and high physical property values.

(*f*) There are too few details of the bean yellow necrosis virus Johnson (21) and the *Dolichos* mosaic virus Capoor and Varma (5) for an accurate comparison to be made.

(*g*) There are other non-legume viruses which result in a similar type of reaction on certain varieties of bean, e.g. tobacco necrosis virus causing stipple streak of bean, van der Want (50) and a tobacco streak strain causing red node of bean, Thomas and Zaumeyer (47, 48). Also the tobacco ringspot virus Pierce (30), tobacco broken ringspot virus, Smith and Markham (39) and a cucumber mosaic virus strain isolated from spinach by Fulton (12). With none of these is there a complete correlation.

From this account of the data available, it seems that the virosis described above cannot be wholly identified with any previously recorded disease.

It shows some similarities with several viruses and is probably related to one of them—meanwhile it is named the bean necrosis virus.

6.—BEAN VIRUS COMPLEX

When beans were inoculated with the sap from several naturally infected *Phaseolus vulgaris* and *Crotalaria spectabilis* plants, two distinct types of local lesions developed, viz. chlorotic spots or blotches and necrotic specks. After several transfers to and from other hosts, it became evident that more than one virus was involved.

For the convenience of others who may have to identify bean viruses, the complex is firstly described as such, and then the symptoms of the individual components are compared.

The virus causing the local chlorosis appears to be identical with the bean local chlorosis virus A, which has already been described and which occurs naturally on its own.

The second component, which results in the local necrotic lesions on bean, is named bean necrotic speckle virus. Apparently, it is not found alone in the field, but only in the complex.

Natural source of virus complex and locality:

(*a*) *Phaseolus vulgaris*. Pretoria and district, Groblersdal and Bronkhorstspruit.

Several varieties showed large chlorotic blotches on the older leaves, and a mottle on the younger ones. These were also crinkled and slightly malformed. Most plants were stunted. On some varieties e.g. Rooikrans there were necrotic specks on the leaves and sunken necrotic areas on the pods.

(*b*) *Crotalaria spectabilis*. Potchefstroom.

The leaves had dark green veinbands with irregular chlorotic areas interveinally. There were short necrotic stem streaks and the plants were stunted.

Throughout this description, the following abbreviations will be used:—

Comp.—virus complex.

BLCV. A.—bean local chlorosis virus A.

BNSV.—bean necrotic speckle virus.

Physical properties: Thermal inactivation point 60–64°C.
Longevity *in vitro* 2–3 days.
Dilution end point 1:1,000–1:5,000.

These values refer to the complex and to the two components.

Transmission: Mechanical sap inoculation.
Aphid transmission tests were inconclusive.

Host range: *Arachis hypogaea* L., *Crotalaria juncea* L., *C. spectabilis* Roth., *Glycine max* (L.) Merr., *Lathyrus odoratus* L., *Lupinus albus* L., *L. luteus* L., *L. mutabilis* Sweet., *Medicago lupulina* L., *M. sativa* L., *Melilotus officinalis* Willd., *Phaseolus acutifolius* Gray var. *latifolius* Freem., *P. lunatus* L., *P. mungo* L., *P. vulgaris* L., *Pisum sativum* L., *Trifolium hybridum* L., *T. incarnatum* L., *T. pratense* L., *T. repens* L., *Vicia faba* L., *Vigna sesquipedalis* (L.) Wight., *V. unguiculata* (L.) Walp., *Voandzeia subterranea* Thouars.

BLCV. A is not able to infect *Glycine max*, *Medicago sativa* or *Trifolium repens*.

Reaction of susceptible species

Arachis hypogaea.

Local. No reaction.

Systemic. With all three viruses a mottle develops.

Crotalaria juncea.

Local. Comp. and BNSV. In nine days there are chlorotic spots with necrotic centres.

BLCV. A. No reaction.

Systemic. Comp. The growing point curves strongly to one side. The leaves are puckered with wavy margins and they have dark green blisters. The plant is rosetted and stunted.

BLCV. A. There is a crinkling of the leaves with a mottle and dark green blisters.

BNSV. After a veinclearing of the young leaves, later formed ones are mottled with a necrotic sheen. The plant is stunted.

C. spectabilis.

Local. No reaction.

Systemic. The symptoms with all three viruses include a veinclearing and/or chlorotic spotting, followed by a mottle with dark green blisters. The leaves are crinkled and the plant is slightly stunted.

Glycine max.

Local. Comp. and BNSV. Chlorotic spots develop in nine days.

Systemic. Both viruses cause a chlorotic spotting on the young leaves, and a mottle and malformation on later formed ones. Fig. 8D.

With BNSV. there are also necrotic specks on the old leaves.

Lathyrus odoratus.

Local. Comp. and BNSV. Small necrotic lesions develop.

BLCV. A. No reaction.

Systemic. With all three, the leaves are rolled and mottled. There are also dark green veinbands with BLCV. A.

Lupinus albus.

Local. Comp. and BNSV. There are small necrotic lesions and the leaflets absciss.

BLCV. A. No reaction.

Systemic. The three viruses induce a veinclearing or chlorotic spotting on the young leaves which remain folded. Later formed leaves are small and chlorotic with dark green blisters, and the plant is rosetted.

With the complex, the stem may become necrotic and the plant collapses.

L. luteus.

Local. No reaction.

Systemic. Comp. The young leaves are mottled and remain folded. Later formed leaves are malformed and almost stringlike, with large dark green blisters. The plant is stunted and rosetted.

BNSV. Chlorotic spots may develop. Later leaves have a dark green band along the midrib which is puckered, and the margins are rolled upwards. The plant is rosetted.

BLCV. A. The leaves are mottled, folded and crinkled.

L. mutabilis.

Local. Comp. There is a general necrosis and the leaflets absciss.

BNSV. and BLCV. A. No reaction.

Systemic. Comp. Necrotic stem streaks develop, the growing point curls to one side, and the plant eventually collapses.

BNSV. If the plants are young when infected, the reaction is similar to that of the complex. On older plants, there is a mottle on the leaves which are small and stringlike, and rosetted.

BLCV. A. The leaves are severely curled and very chlorotic with dark green blisters.

Medicago lupulina.

Local. No reaction.

Systemic. With the complex there are areas with mosaic markings, but with the other two viruses there is a mottle with dark green veinbands.

M. sativa.

Local. No reaction.

Systemic. Both the complex and BNSV cause a diffuse chlorotic spot mottle, and a slight malformation of the leaves.

Melilotus officinalis.

Local. No reaction.

Systemic. Comp. and BLCV. A. There is a mottle with chlorotic streaks and the leaves are malformed.

BNSV. Only a chlorotic mottle develops.

Phaseolus acutifolius.

Local. All three viruses induce a chlorotic spotting with necrotic veins or rings. The leaves collapse.

Systemic. Comp. The young leaves develop a veinclearing with necrosis, and they are severely curled. Later leaves have a speck mottle.

BNSV. This necrosis usually results in the collapse of the growing point. Should any secondary shoots develop, they have small, malformed and mottled leaves.

BLCV. A. There is a yellow network only.

P. lunatus.

Local. Comp. Chlorotic spots with necrotic specks develop.

BNSV. There are small necrotic specks in nine days.

BLCV. A. Chlorotic spots develop in four days.

Systemic. Comp. and BLCV. A. After a veinclearing, there are chlorotic flecks along the veins on most leaves.

BNSV. On the first trifoliates to show symptoms, there is a chlorotic network which soon becomes necrotic. Later formed leaves are speckled.

P. mungo.

Local. Same as for P. lunatus.

Systemic. Comp. The younger leaves develop chlorotic spots, each with a necrotic ring.

BNSV. After a chlorotic spotting on the young leaves, the next formed have dark green veinbands with irregular shaped chlorotic areas, which cause a distortion of the laminae. There are necrotic specks on the older leaves.

BLCV. A. Irregular chlorotic areas develop on some leaves.

P. vulgaris var. Canadian Wonder.

Local. Comp. In 4–5 days small necrotic specks develop which may fuse with closely adjacent ones. After six days there are also chlorotic spots, which develop independently from the specks. Fig. 8A.

BNSV. In 2–3 days necrotic specks develop.

BLCV. A. There are chlorotic spots in 4–5 days.

Systemic. Comp. The first trifoliates show large chlorotic blotches in 12–14 days. Young leaves have chlorotic spots, and later ones develop a mottle with dark green blisters. They are slightly puckered and may have twisted tips. The pods are mottled. Fig. 8B.

BNSV. After a chlorotic spotting of the young leaves, later ones develop a mottle, with dark green blisters. These leaves are malformed and elongated, and the plant is stunted.

BLCV. A. There is a veinclearing of the young leaves; later formed ones are mottled, crinkled and slightly malformed.

vars. Black Wonder and S.A. Black and White.

Local. Comp. and BLCV. A. Same as for Canadian Wonder.

BNSV. There are necrotic rings in addition to the necrotic specks.

Systemic. Same as for Canadian Wonder.

vars. Idaho Refugee, Long Tom, Tendergreen and Victor.

Local. Comp. Very few necrotic specks develop.

BNSV. and BLCV. A. Similar to that on Canadian Wonder.

Systemic. Same as for Canadian Wonder.

var. Haricot.

Local. Comp. In addition to the symptoms described for Canadian Wonder, there is a necrosis of the veins and petioles.

BNSV. There are necrotic specks, veins and petioles, Fig. 8C.

BLCV. A. Same as Canadian Wonder.

Systemic. Comp. and BNSV. There are necrotic specks and stem streaks which may result in the collapse of the plant.

BLCV. A. Similar to Canadian Wonder.

Pisum sativum.

Local. Comp. After a general necrosis the leaves collapse.

BLCV. A. The veins become necrotic and the leaves collapse.

BNSV. Necrotic spots develop.

Systemic. Comp. and BLCV. A. There is a veinclearing of the young leaves.

Later formed ones are mottled with necrosis setting in, in the chlorosis. The plant usually collapses.

BNSV. Most leaves develop chlorotic spots and veins, which soon become necrotic. The leaves remain folded, the tendrils are abnormally curled and the plant is rosetted. Later, necrotic stem streaks develop, which may lead to the ultimate collapse of the plant.

Trifolium hybridum.

Local. BNSV. There are diffuse chlorotic spots, with dark green rings.

Comp. and BLCV. A. No reaction.

Systemic. BNSV. There are chlorotic spots, streaks and ringspots.

Comp. and BLCV. A. A chlorotic streaking develops.

T. incarnatum.

Local. Comp. Chlorotic spots with necrotic rings develop.

BNSV. There are necrotic rings and a general chlorosis.

BLCV. A. Chlorotic spots develop.

Systemic. All three viruses cause a veinclearing, and later a mottle with dark green areas, veinbands or blisters. With the complex and BLCV. A. the leaves are severely crinkled. With BNSV. necrosis may set in, in the chlorosis and the plant may collapse.

T. pratense.

Local. Comp. and BNSV. Small necrotic lesions may develop.

BLCV. A. No reaction.

Systemic. Comp. There are chlorotic blotches on the old leaves and chlorotic streaks on the younger ones. Necrosis may set in, in the latter, resulting in a distortion of the laminae.

BLCV. A. Similar symptoms develop.

BNSV. This virus is latent in the young leaves.

T. repens.

Local. No reaction.

Systemic. Comp. and BNSV. A chlorotic streak mottle develops, or there are no symptoms.

Vicia faba.

Local. Comp. Small necrotic specks develop.

BNSV. In addition there are necrotic rings.

BLCV. A. There are necrotic specks and chlorotic spots in 4–5 days.

Systemic. Comp. The older leaves develop large necrotic lesions which spread and fuse, and the leaves drop. This necrosis may continue into the growing point which then collapses; or the young leaves may be mottled.

BNSV. Very diffuse chlorotic spots with necrotic specks develop on the young leaves. Later formed leaves have almost yellow spots which soon become necrotic. Most leaves drop.

BLCV. A. After a chlorotic spotting, there is a mottle.

Vigna sesquipedalis.

Local. Comp. There are chlorotic spots with necrotic specks and veins. The leaves soon drop. Fig. 8E.

BNSV. Only the necrosis develops.

BLCV. A. Only the chlorotic spotting occurs.

Systemic. Comp. and BNSV. There is a veinclearing of the young leaves. Later formed ones have dark green specks, veinbands and blisters, and they are rolled downward.

BLCV. A. No reaction.

V. unguiculata.

Local. With all three viruses there are necrotic specks and/or veins.

Systemic. The three viruses induce a chlorotic network followed by a mottle on later formed leaves.

With BNSV. there are also dark green blisters.

Voandzeia subterranea.

Local. Comp. and BNSV. Small chlorotic spots develop.

BLCV. A. No reaction.

Systemic. Comp. There are chlorotic spots and flecks on the young leaves. Later leaves have dark green veinbands and a necrotic sheen.

BNSV. The young leaves have chlorotic spots, with necrosis setting in.

BLCV. A. There is a chlorotic mottle.

IDENTIFICATION.

This virus complex consists of two distinct components, which differ considerably in their individual symptom expression on most of the host plants tested.

The component causing the local chlorosis on bean has already been designated bean local chlorosis virus A—one of a group of viroses which result in this characteristic reaction.

On some varieties of bean this same type of local chlorosis occurs with the alfalfa yellow mosaic virus of Zaumeyer (53), but on many other host plants the symptoms do not agree.

With the alfalfa yellow mosaic, bean varieties develop either a local necrosis or a local chlorosis—never both symptoms simultaneously.

The second component, which causes small local necrotic lesions on bean, is named bean necrotic speckle virus. This symptom occurs both locally and systemically on many host plants, and on some species it is lethal.

Again, there are similarities in symptom expression on some varieties of bean, with those caused by alfalfa yellow mosaic virus, but differences on other hosts preclude complete correlation. Further, the host range of alfalfa yellow mosaic includes more susceptible species and it can withstand higher temperatures.

There are several other viruses, which, on some varieties of bean, cause the same combination of symptoms as occur with bean necrotic speckle virus, viz. local necrosis with systemic chlorosis.

The bean mosaic virus 4, Zaumeyer (56) and pod mottle virus, Zaumeyer (58) both have very restricted host ranges, and strong resistance to heating and ageing. The pea streak virus, Chamberlain (7) also withstands a very high dilution.

Although the red node virus, Thomas and Zaumeyer (47), yellow dot virus, Thomas and Zaumeyer (44) and white clover mosaic virus complex, Zaumeyer and Wade (60) do cause both local necrosis and systemic chlorosis, the descriptions of the type of symptom do not agree with those induced by bean necrotic speckle virus.

The local lesion strain of bean yellow mosaic virus, Thomas and Zaumeyer (49) results in similar symptoms on some bean varieties, but there are considerable differences in the symptoms on other plants, the host ranges and physical properties.

In England, a virus similar to the bean necrotic speckle virus was found on broad bean, also in combination with one causing local chlorotic spots on bean (22).

At the time, it was considered a new virus, but from recent literature, it now appears to be related to the lucerne (alfalfa) mosaic virus group.

There is a considerable resemblance between this virus and some of the many strains of lucerne mosaic, in respect of symptoms on several hosts, legume host range, and some physical property values; but it cannot be completely identified with any one of these variants.

It is therefore described here as a possible new strain and named bean necrotic speckle virus.

BEAN YELLOW MOSAIC VIRUS

This virus is common on naturally infected *Lupinus albus* and *L. angustifolius*, in the Western Province. It has therefore been described in the paper on lupin virus diseases.

BEAN YELLOW MOSAIC VIRUS, NECROTIC STRAIN

This strain was found on naturally infected *Lathyrus odoratus* in Pretoria and district. It is described under sweet pea virus diseases.

LUPIN VIRUS B

This virus was also found on beans growing near various species of *Lupinus* in the Western Province. Details are given in the paper on lupin virus diseases.

In the field the symptoms are mild—only a chlorotic mottle and slight crinkling of the leaves.

PEA WILT VIRUS STRAIN

In an experimental plot of Kentucky Wonder beans in the Rustenburg area, many plants showed vivid yellow spots on the leaves. There was also mottling, veinbanding and puckering, and the plants were stunted. This virus is described under pea virus diseases.

Summary

Details are given of bean virus diseases in South Africa, viz. four viruses and their several variants, and one virus complex. Mention is also made of a further two viruses and two strains, which have been described under other headings.

(*a*) Bean mosaic virus—the presence of this virus was confirmed.

(*b*) Bean mosaic virus strain—about 12 per cent seed transmission in the variety Canadian Wonder of unknown origin. Differs from the type virus in having a wider host range; and thermal inactivation point of 60–62°C., and longevity *in vitro* of 2–3 days.

(*c*) Bean chlorotic ringspot virus with four strains—probably related to the tobacco ringspot group. As the name suggests, this virus causes distinct ringspot patterns on the inoculated leaves of bean. It was isolated from *Crotalaria juncea*, *Erythrina caffra*, *Glycine max* and *Voandzeia subterranea*. The strains withstand heating to between 56–62°C., ageing between one and four days and dilutions of between 1:1000–1:10,000.

(*d*) Bean local chlorosis virus and seven variants—isolated from species of *Crotalaria*, *Glycine*, *Lathyrus*, *Medicago*, *Phaseolus* and *Trifolium*. The virus is named after the marked local chlorotic spotting on bean. The thermal inactivation points of the strains vary between 56–65°C., the longevity *in vitro* is between one and four days and the dilution end points are between 1:1000 and 1:5000.

(*e*) Bean necrosis virus—isolated from *Crotalaria spectabilis*, *Dolichos lablab* and *Glycine javanica*. Although the symptoms on the original host plants are mild, on bean there is a lethal necrosis. The virus is inactivated at temperatures of 65–70°C., after 6–7 days ageing, and at dilutions of between 1:5000–1:10,000. The relationship of this virus to others is uncertain.

(*f*) Bean virus complex. With isolates from *Phaseolus vulgaris*, *Crotalaria spectabilis* and *Glycine javanica*, two distinct local reactions developed on bean. One component was identified as a variant of the bean local chlorosis virus, and the other was named bean necrotic speckle virus. The latter is probably related to the lucerne mosaic virus group. For both components the thermal inactivation point is between 60–64°C., the longevity *in vitro* 2–3 days, and the dilution end point between 1:1000 and 1:5000.

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FIG. 1.—BEAN MOSAIC VIRUS.

Phaseolus vulgaris vars.

A and B. Canadian Wonder, from infected seed. A. Primary leaves. B. Trifoliate leaves. C. Long Tom. D. Idaho Refugee. E. Kentucky Wonder. C–E. Artificial infection.

FIG. 2.—BEAN MOSAIC VIRUS.

Phaseolus vulgaris var. Haricot, from infected seed.

FIG. 3.—BEAN MOSAIC VIRUS STRAIN.

Phaseolus vulgaris var. Canadian Wonder.

A. From infected seed. B. Artificial infection.

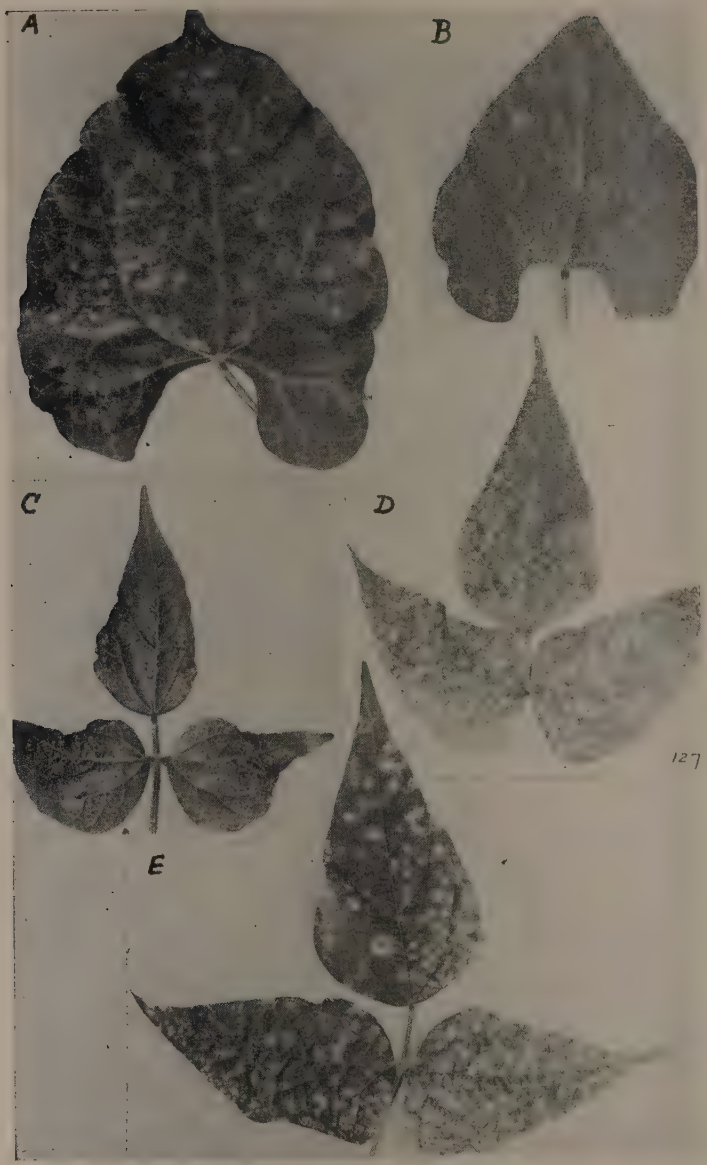

FIG. 4.—BEAN CHLOROTIC RINGSPOT VIRUS.
Phaseolus vulgaris.

A. var. Canadian Wonder, local lesions. B. var. Haricot, local lesions. C–E var. Canadian Wonder, systemic symptoms.

FIG. 5.—BEAN CHLOROTIC RINGSPOT VIRUS.

A. *Crotalaria juncea.* B. *C. spectabilis.* C. *Voandzeia subterranea.* D. *Phaseolus acutifolius.* E. *P. lunatus.* F. *Melilotus officinalis,* G. Pod of *Phaseolus vulgaris* var, Canadian Wonder, H and I, *Glycine max,*

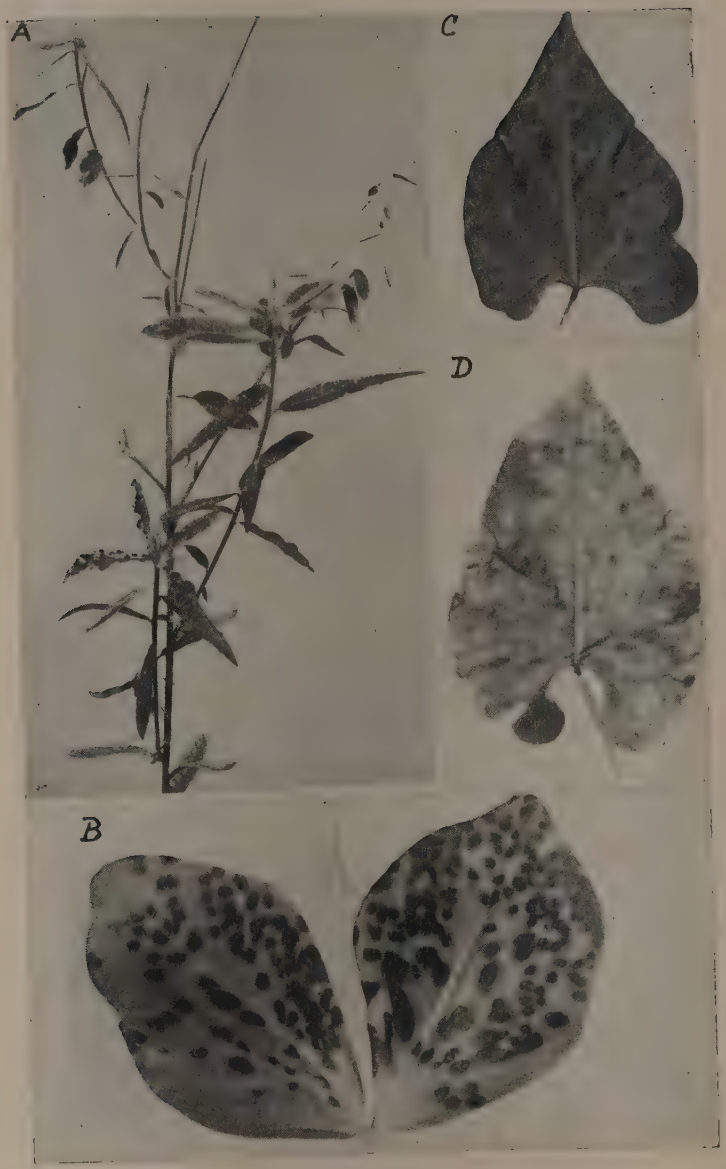

FIG. 6.—BEAN LOCAL CHLOROSIS VIRUS.

A. *Crotalaria juncea.* B. *Vicia aba.* C and D. *Phaseolus vulgaris* var. Canadian Wonder.

FIG. 7.—BEAN NECROSIS VIRUS.

A. *Phaseolus vulgaris* var. Canadian Wonder, systemic necrosis. B. *Melilotus officinalis*. C. *Phaseolus lunatus*. D. *Trifolium hybridum*. E. *Phaseolus vulgaris* var. Canadian Wonder, local reaction.

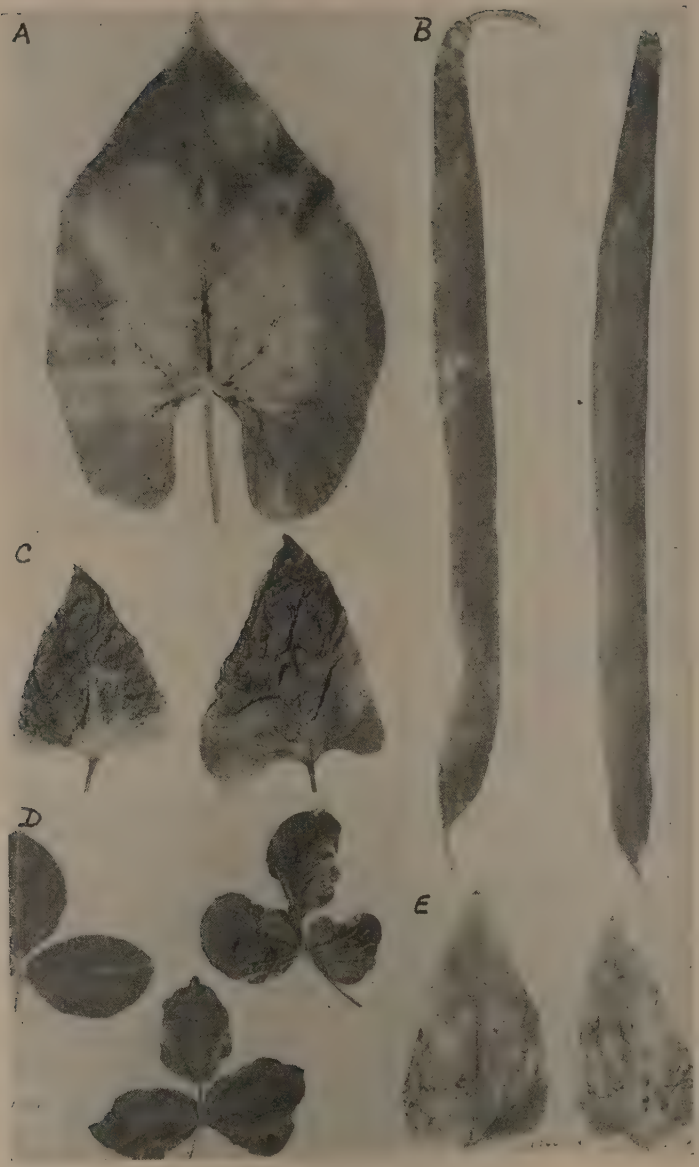

FIG. 8.—BEAN VIRUS COMPLEX.

A–C. *Phaseolus vulgaris*. A. var. Canadian Wonder, local reaction with the complex. B. Pods of var. Canadian Wonder. C. var. Haricot, local lesions with the bean necrotic speckle virus. D. *Glycine max*. E. *Vigna sesquipedalis*.

A Contribution to our Knowledge of the Freshwater Algae of the Transvaal Province

by

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(*Being an abridged form of the thesis presented in partial fulfilment of the degree of Master of Science at the University of Pretoria*)

CONTENTS

I. Introduction.
II. Enumeration of the Taxa.
III. Vegetative Reproduction in Desmids.
IV. Summary.
V. Literature.

I. INTRODUCTION

The freshwater algae occurring in the Transvaal districts of Warmbaths, Nylstroom and Naboomspruit have apparently not been investigated before. This study consisted of an enumeration of the taxa found, an investigation of vegetative reproduction in Desmids and a few hydrobiological observations.

The classification adopted here is essentially that of Wettstein (1935), W. and G. S. West (1904) and Hustedt (1930). Soon after the investigation was begun, it became apparent that many of the taxa found did not correspond with any already known and described. The new ones are described and illustrated in this paper.

It was possible to investigate cell division in the Desmids in living material; the rate of cell division proved to be of particular interest.

As it was impracticable to collect samples regularly from the various localities, no systematic hydrobiological observations could be made on variations in pH, periodicity, diurnal and annual fluctuations in temperature, etc., but where possible the pH of the water was measured at the time the material was gathered.

Collection and Preservation of Samples.—Samples were taken with a tablespoon from deposits on submerged rocks and mud in shallow pools, springs and small streams. Glass vials of 30 ml. capacity with plastic screw caps were used for keeping the samples. Twenty-seven ml. of the sample and 3 ml. of 40 per cent formalin were added to a vial.

Where living material was to be studied, the samples were placed in one-quart Ball jars together with a large volume of the water in which they had been found. The mouth of each jar was covered with a piece of waxed paper held in place by a rubber band.

Mounting of the Material.—It was found best to mount the algae in the liquid in which they were preserved or, to prevent drying out, in glycerine. Living material was mounted in the water in which the sample was collected or in distilled water. Where necessary a drop of distilled water was added to compensate for evaporation during microscopic examination.

Drawings.—Accurate scale drawings were made by means of a micrometer-net-ocular on specially printed squared paper.

Type material.—Owing to the fact that it is practically impossible to preserve the type material successfully over many years in a liquid medium, the author desires that the drawing plus the description of the new taxa described in the present paper constitute the type.

Enumeration of the Samples and Localities.—The samples were collected in the districts of Warmbaths, Nylstroom and Naboomspruit in the Northern Transvaal. The average altitude of the country exceeds 3,500 feet above sea-level, the maximum being about 5,000 feet. The area consists largely of sandstone with scattered groups of red-granite, diabase and quartz; but the lower country, south of Warmbaths and Naboomspruit, consists of basalt.

The following list of samples collected serves as a key; in the systematic portion of this paper, only the numbers of the samples are cited. Most of the samples were collected over a period extending from April, 1954 to July, 1955. The principal localities where collections were made are shown in Figure 1.

A.—*Doornfontein and Leeupoort*

Situated about 13 miles N.-N.W. of Nylstroom. The samples were collected from the Doornfontein Spruit and Leeupoort Dam. The locations are shown in Figure 2.

1. Greyish-brown deposit covering submerged stones in the spruit near drift, about half a mile S.W. of Leeupoort Dam, in slow-running water, 16·4·54; pH 6.2.
2. Greenish-brown ooze from side of road near drift, 16·4·54.
3. Reddish-brown ooze from side of road halfway between drift and Leeupoort Dam, 16·4·54.

The following samples were collected mainly from pools on rocks below the overflow on the S.W. side of Leeupoort Dam, 16·4·54.

4. Greenish-brown, stagnant water.
5. Orange masses floating on surface of small pool.
6. Reddish-brown deposit, stagnant water.
7. Attached to inner side of embankment of Leeupoort Dam, below surface of the water.
8. Decaying plants on moist part of embankment.
9. In pool on rocks, yellowish-brown.
10. Orange ooze on rocks.
11. Dirty orange-brown scum.
12. Greyish-brown deposit on bottom of pool next to spruit; pH 6.15.

Samples 13 to 17 were collected from Doornfontein Spruit about one mile N.E. of Leeupoort Dam (underneath bridge on asphalt road between Nylstroom and Vaalwater), 16·4·54.

13. Orange-brown growth among stones, N.E. side of stream under bridge, pH 6.35.
14. Orange- to greenish-brown scum next to 13.
15. Dirty orange-brown deposit, N.W. side under bridge, slow-running water.
16. Orange deposit from S.W. side under bridge, in placid water.
17. Greyish-brown deposit, from flowing water-furrow.

Samples collected near school about three miles N.E. of Leeupoort Dam, 16·4·54.

18. From pond, dirty orange- to greenish-brown scum, pH 5.75.
19. In furrow near pond, greyish-brown deposit.

Samples from Doornfontein Spruit about three miles N.E. of Leeupoort Dam, near school, 16·4·54.

20. From pool near stream, pH 6.1.
21. Another pool near the stream.
22. Orange-brown ooze from side of same pool as in 21.
23. Greenish-brown deposit on stones at drift, in running water, pH 6.25.

B.—*Moddernek*

Situated about nine miles N.-N.W. of Nylstroom. The part of the farm from which collections were made belongs to Mr. P. W. Botes. The samples were collected from springs, small ponds and water-furrows. The locations are shown in Figure 3.

24. Floodwater S.W. of spring A, 22·4·54.
25. Bottom of small pond (S. side), almost black deposit; about 90 yards S. of spring A, 22·4·54; pH 5.8.
26. Same as 25, 19·11·54.
27. Furrow between spring A and small pond, about 85 yards from spring A, 22·4·54.
28. *Spirogyra* species floating on surface of small pond, 22·4·54.
29. On E. side of larger pond, about 145 yards S. of spring A, 22·4·54.
30. On W. side of same pond, 2·4·55.
31, 32 and 33. Sides, surfaces and bottoms of furrows S. of the pond, 22·4·54.
34 and 35. From a vlei about three-quarters of a mile S.E. of spring A, 19·11·54; pH 6.31.
36. Near 25 and 26, 2·4·55; pH 5.85.
37. W. side of small pond, 2·4·55.
38. N. side of small pond, 2·4·55.
39. Spring B, 2·4·55; pH 5.45.
40. Spring A, orange scum from side, 2·4·55; pH 5. (This sample did not contain any algal flora.)
41. Furrow halfway between spring B and small pond, 2·4·55.

C.—*Rietfontein* 288

Situated about 28 miles N.-N.W. of Nylstroom. The farm belongs to Mr. J. E. Theron.

42. From spring, 6·4·55; pH 5.7.
43. Water from spring flowing into pond N.W. of spring, 6·4·55.
44. From N.E. side of vlei, W. of pond, 6·4·55.

D.—*Glentig*

A farm belonging to Mr. L. J. Groenewald; situated about seven miles E. of Rietfontein 288.

45. From spring, 21·11·54; pH 5.5.
46. From furrow, about 30 yards N. of spring, 21·11·54.

E.—*Warmbaths*

Samples collected between the old and new bridges over the Plat River, about 3–4 miles W. of Warmbaths; leg. Cholnoky.

47. Almost stagnant water in deep part of river, 30·5·54.
48. Slightly lower down, deposits on a flat stone, slow-running water, 30·5·54.
49. In shade of new bridge in slow-running water, brown covering on sand, 30·5·54.
50. Near 49, deep bend in river in slow-running water, 30·5·54.

F.—*Between Warmbaths and Nylstroom*

Samples from a tributary of the Nyl River and other places near the road about halfway between Warmbaths and Nylstroom; leg. Cholnoky.

51. Side of waterfall W. of road, swift-running water over sandstone, 6·6·54.
52. A small tributary, slow-running water, 6·6·54.
53. On rocks, stagnant water, 6·6·54.
54. Shallow water from river above the waterfall, 6·6·54; pH 6.35.

Samples collected in a vlei E. of the road; pH 6.2.

55. About 200 yards from bridge, beginning of a vlei, stagnant water, 6·6·54.
56. Small pools further down the vlei, 6·6·54.
57 and 58. Two places in the vlei on *Gramineae* and *Cyperaceae*, 6·6·54.

G.—*Kranskop*

Situated about seven miles E. of Nylstroom; leg. Cholnoky.

59. Small pond with partly broken bank, about 100 yards in diameter, stagnant water with *Marsilea* and *Nymphaea*, 6·6·54; pH 6.75.
60. Overflow of pond, swift-running water, 6·6·54.

Samples from a tributary of the Nyl River near Kranskop.

61. Shallow water near the bank, 6·6·54.
62. Deeper, slow-running water from the main part of the stream, 6·6·54.

H.—*Modderpoort*

The farm belonging to Mr. G. Moerdyk between Warmbaths and Nylstroom, not far from the locality where samples 51–58 were collected; leg. Cholnoky.

63 and 64. Further from the road to the west, two samples collected on stones in the river, 6·6·54; pH 6.2.

I.—*Mosdene*

Samples collected on the farm of Mr. E. A. Galpin, near Naboomspruit, 12·7·55; pH 6.1–6.4; leg. Cholnoky.

65. From the portion of the farm called Masoga, in a swimming pool among *Myriophyllum*.
66. From the shallow part of a vlei with a sandy bottom on Masoga.
67. Same locality as 66 but in deep water among Green Algae.
68. Wall of Premier Dam, overflow, slow-running water, among *Marsilea*.
69. From Premier Dam; the bottom of the dam was sampled at a place far from the bank, and where the water was one metre deep.
70. A vlei situated between the Premier Dam and the Nyl River; in water about 10 cm. deep.
71. Near 70, in a furrow near the Nyl-road.
72. From the Nyl River, in swift-running water, on marshy sand; clearly oligotrophic.
73. From the Nyl Dam near the Nyl River, large algal masses.
74. Premier Dam, living material; leg. Dr. S. Saubert.

Geographical Distribution.—In the taxonomic part of this paper, the general geographical distribution of each taxon of the Desmidiaceae encountered has been added. As the author was unable to study all literature dealing with Desmids, the details regarding their geographical distribution must needs be considered incomplete.

II.—ENUMERATION OF THE TAXA

TRIBUS: SCHIZOPHYTA

Class: Schizophyceae (Cyanophyceae).
Order: Chroococcales.
Fam.: Chroococcaceae.

Merismopedia *Meyen*

1. *M. convoluta* Bréb. (Geitler & Pascher: Süsswasserflora, 12, 1925, p. 106.) Sample 20.
2. *M. glauca* (Ehrenb.) Näg. (Geitler & Pascher: Süsswasserflora, 12, 1925, p. 106, fig. 125.) Samples 47, 48.
3. *M. punctata* Meyen. (Geitler & Pascher: Süsswasserflora, 12, 1925, p. 106, fig. 124.) Samples 39, 48.

Order: Hormogonales.
Fam.: Stigonemataceae.

Stigonema *Ag.*

4. *S. pseudominutum* spec. nova, *S. minuto* (Ag.) Hass. affinis, sed filamentis et hormogoniis tam angustus ut vel 5 μ aequantibus, vaginis filamentorum vetustiorum luteo-fulvis et heterocystis nonnumquam etiam terminalibus differt.

Except for the considerably narrower threads and hormogonia this agrees with *S. minutum* (Ag.) Hass. (Geitler & Pascher: Süsswasserflora, 12, 1925, p. 186, figs. 224, 225); the heterocysts occupy terminal as well as lateral and intercalary positions. The cells are arranged in 1–4 series, but mainly in a single series. The threads are well-branched, the branches being narrower than the main axis. The older sheaths are yellowish-brown in colour whereas the younger sheaths are colourless. Diameter of threads 5–20 μ. (Tab. 1, figs. 1, 2.) Sample 27.

Fam.: Scytonemataceae.

Scytonema *Ag.*

5. *S. myochrous* (Dillw.) Ag. (Geitler & Pascher: Susswasserflora, 12, 1925, p. 275, figs. 324, 325.) Threads narrower than in the typical form and some of the cells are shorter than broad; parts of the sheath lack the diverging layers. Breadth of thread 10–24 μ; breadth of cells 5–7 μ; length of cells 3–6 μ; breadth of heterocysts 8 μ; length of heterocysts 9–10 μ. (Tab. 1, figs. 3–7.) Sample 22.

Fam.: Nostocaceae.

Nostoc *Vaucher*

6. *N. commune* Vaucher (Geitler & Pascher: Süsswasserflora, 12, 1925, p. 301, fig. 350). Sample 29.
7. *N. nylstromicum* spec. nova, *N. muscorum* Kütz. affinis, sed heterocystis cylindratis (nunquam apice rotundatis) valde distincta. „ Dauerzellen " abesse videntur.

This species comes nearest to *N. muscorum* Kütz. (Geitler & Pascher: Süsswasserflora, 12, 1925, p. 299, fig. 349), but can be distinguished by the shape of the heterocysts which are cylindrical in outline; no " Dauerzellen " were observed. Trichomes loosely twisted, blue-green in colour; cells cylindrical, 2·8–3·6 μ broad and 3·5–8·75 μ long. Heterocysts 3·85–4·4 μ broad and 5·6–9·5 μ long. A number of trichomes within a common mucilaginous sheath. (Tab. 2, fig. 2.) Sample 20.

8. *N. pseudogelatinosum* spec. nova, *N. gelatinoso* Schousboe affinis, sed differt magnitudine aliquanto minore et cellulis interdum non longioribus quam latioribus; constrictio saeptorum magis conspicua, heterocystorum nulla nisi terminalia sunt, neque ullae „ Dauerzellen " adesse videntur.

This differs from *N. gelatinosum* Schousboe (Geitler & Pascher: Süsswasserflora, 12, 1925, p. 298, fig. 347) in having smaller dimensions, more marked constrictions at the septa, terminal heterocysts, no " Dauerzellen " and cells which can be as long as they are broad. Trichomes irregularly twisted, blue-green in colour; cells quadrate or cylindrical, 2·4–2·8 μ broad and 2·4–6·3 μ long; heterocysts always occupy a terminal position, more or less elliptical in outline, 3·1–4 μ broad and 5·5–7·9 μ long. Only the common sheath, within which a number of trichomes occur, is distinct and of a dirty yellowish colour. (Tab. 2, fig. 1.) Sample 20.

Anabaena *Bory*

9. *A. galpinii* spec. nova, *A. affini* Lemm. affinis, sed trichomatis semper separatis, vaginae mucosae abesse videntur; cellulae breviores quam latiores. „ Dauerzellen " iuxta heterocysta sitae sunt.

This species differs from *A. affinis* Lemm. (Geitler & Pascher: Süsswasserflora, 12, 1925, p. 320, fig. 374) in having individual trichomes (not containing a number of trichomes within a common sheath), in the absence of a sheath, in the position of the " Dauerzellen " (adjacent to the heterocysts), and in the cells being shorter than broad. Trichomes free-floating, straight, blue-green in colour; cells 8·5–9 μ broad and 4·3–6·8 μ long; heterocysts more or less spherical, 8·5–9 μ broad and 8–9 μ long. " Dauerzellen " single, oval, bright blue-green in colour and more granular than the vegetative cells, about 11 μ broad and 16 μ long. (Tab. 2, fig. 3.) Sample 66.

Named after Mr. E. A. Galpin of Mosdene, Naboomspruit.

10. *A. mesiana* spec. nova, *A. catenulae* (Kütz.) Born. et Flah. affinis, sed differt et trichomatis semper separatis et quod vagina mucosa abest. „ Dauerzellen " breviores adsunt.

This species is near *A. catenula* (Kütz.) Born. et Flah. (Geitler & Pascher: Süsswasserflora, 12, 1925, p. 318, fig. 370); however the trichomes are single and the " Dauerzellen " are not as long as in Born. and Flah.'s species. Trichomes free-floating, straight, blue-green in colour; no sheaths were discernible. Cells spherical or slightly elliptical, 5–6 μ broad and 5–7 μ long. " Dauerzellen " single, adjacent to the heterocysts, oblong, 7·5–8 μ broad and 11·5–19 μ long. (Tab. 2, fig. 4.) Sample 66.

This species is named after the late Prof. Dr. M. G. Mes, formerly Head of the Department of Plant Physiology and Biochemistry, University of Pretoria.

11. *A. pseudocatenula* spec. nova, *A. catenulae* (Kütz.) Born. et Flah. affinis, sed eo differt quod separata sunt trichomata, vagina mucosa abesse videtur, cellulae vero minores sunt ac breviores quam latiores neque ullae „ Dauerzellen " visae sunt.

This species closely resembles *A. catenula* (Kütz.) Born. and Flah., but the trichomes are single, the cells are smaller and shorter than broad and no sheaths or " Dauerzellen " were observed. Trichomes free-floating, straight, blue-green in colour. Cells 3·16–3·65 μ broad and 1·58–3·5 μ long. Heterocysts elliptical, 3·5 μ broad and 6·63 μ long. (Tab. 2, fig. 5.) Sample 1.

Fam.: Oscillatoriaceae.

Oscillatoria *Vaucher*

12. *O. nylstromica* spec. nova, *O. simplicissimae* Gom. affinis, sed trichomatis angustioribus subcaeruleisque, cellulis brevioribus vel tam longis quam latis bene distinguenda.

This species agrees superficially with *O. simplicissima* Gom. (Geitler & Pascher, Süsswasserflora, 12, 1925, p. 364, fig. 429), but the trichomes are narrower, and light steel-blue in colour, and the cells are shorter than broad, or quadrate. Trichomes solitary, free-floating, more or less straight, not tapering towards the extremities, 4·6–4·75 μ broad. Cells granular at the septa and not constricted, 1·45–4·8 μ long. Apical cell broadly rounded, without calyptra. (Tab. 2, fig. 7.) Samples 1, 11.

13. *O. princeps* Vaucher. (Geitler & Pascher: Süsswasserflora, 12, 1925, p. 358, fig. 421.) Sample 47.

14. *O. subpristleyi* spec. nova, *O. pristleyi* W. et G. S. West affinis, sed valde differt quod trichomata extrema non curvantur et quod cellulae paulo angustiores porro longiores quam latiores sunt neque ad saepta constrictae.

This specimen closely resembles *O. pristleyi* W. et G. S. West (Geitler & Pascher: Süsswasserflora, 12, 1925, p. 371, fig. 451), but differs from the latter in the absence of a curvature near the apex, the narrower trichomes, the cells being longer than broad and in the absence of constrictions at the septa. Trichomes solitary, free-floating, bright blue-green in colour, more or less straight, tapering towards the extremities, cells 3·16–5·5 μ broad and 4·7–9·5 μ long, granular at the septa. Apical cell slightly pointed, without calyptra. (Tab. 2, fig. 6.) Sample 1.

15. *O. tenuis* Ag. (Geitler & Pascher: Süsswasserflora, 12, 1925, p. 362, figs. 427, 428a.) (Tab. 2, fig. 8.) Samples 1, 5, 7, 9, 11, 12, 13, 14, 15, 18.

16. *O. waterbergensis* spec. nova, *O. annae* van Goor affinis, sed differt eo quod cellulae ad saepta non nisi levissime constrictae, breviores vel paulo longiores quam latiores et ad saepta granulatae sunt neque trichomata ad apicem sunt curvata.

This species agrees superficially with *O. annae* van Goor (Huber-Pestalozzi: Die Binnengewässer, Band XVI, Teil 1, p. 232, fig. 171); but some of the cells are longer than broad, and the trichomes lack a curvature near the apex, are slightly constricted at the septa and are granular. Trichomes more or less straight, greyish-green in colour, not tapering towards the extremities, 7–7·5 μ broad. Cells 4·75–8 μ long; apical cell rounded, without calyptra. (Tab. 2, fig. 9.) Sample 1.

Lyngbya *Ag.*

17. *L. uliginosa* spec. nova. Nulla affinitate obvia. Cellulae vel tam longae quam latae vel etiam longiores, filamentis ad saepta manifeste constrictae sunt; filamenta separata sunt neque vagina mucosa arte ad trichomata adhaeret.

Threads straight, solitary, free-floating, 4·5–5·1 μ broad; sheath of the filament thin, colourless, encircling the trichome loosely. Trichomes constricted at septa, 2·8–3·3 μ broad; cells 2·8–6·2 μ long, dark green in colour; apical cell rounded. (Tab. 2, fig. 10.) Sample 3.

TRIBUS: MONADOPHYTA

Class: Flagellatae.
Order: Euglenineae.
Fam.: Euglenaceae.

Euglena *Ehrenb.*

18. *E. spirogyra* Ehrenb. var. *major* var. nova. Haec specimina multo maiora sunt quam typus et varietates speciei adhuc notae, neque ullae formae intermediae visae sunt.

This variety is much larger than the type and its varieties, with the exception of var. *suprema* Skuja (Huber-Pestalozzi: Die Binnengewässer, Band XVI, Teil 4, p. 102, fig. 83), from which it differs in shape and breadth of cells. Cells 152–196 μ long and 22–26 μ broad. (Tab. 32, fig. 11.) Samples 25, 39.

As most Flagellates are either completely dissolved or quite unidentifiable in formalin-treated material, examination of living material must be made for their recognition. Several unidentifiable *Euglena* species were found in samples 2, 23, 24, 25, 26, 27, 34, 35, 36 and 47.

Phacus *Dujardin*

19. *Ph. pleuronectes* (O.F.M.) Duj. (Pascher & Lemmermann: Süsswasserflora, 2, 1913, p. 138, fig. 236.) Samples 1, 12, 32, 34, 35.

TRIBUS: CONJUGATOPHYTA

Class: Conjugatae.
Fam.: Mesotaeniaceae.

Cylindrocystis *Menegh.*

20. *C. barbarica* spec. nova, affinis *C. crassae* De Bary, sed cellulis 1·2–1·4-plo longioribus quam latioribus, etiam forma chromatophorum differt, quippe quibus processus minus sint radiantes.

This species superficially agrees with *C. crassa* De Bary (W. & G. S. West, Monogr. Brit. Desm., Vol. I, 1904, p. 59, Pl. IV, figs. 33–38); but the cells are about 1·2–1·4 times longer than broad and the chloroplasts possess fewer radiating processes. Cells small, unconstricted, subcylindrical, with the apices broadly rounded; cell wall smooth and colourless; chloroplasts stellate with a few radiating processes. Length 28–32 μ; breadth 23–24 μ. (Tab. 3, fig. 1.) Sample 19.

21. *C. caffra* spec. nova, affinis *C. brébissonii* Menegh., sed cellulis latioribus, etiam forma chromatophori differt.

This species somewhat resembles *C. brébissonii* Menegh. (W. & G. S. West, Monogr. Brit. Desm., Vol. I, 1904, p. 58, Pl. IV, figs. 23–32; Pl. V, fig. 10); but the cells are broader than in Meneghini's species and the shape of the chloroplast differs. Cells of medium size, cylindrical, unconstricted, about 1·7–2·6 times longer than their diameter, apices rounded, chloroplasts with a few radiating prolongations; cell wall smooth and colourless. Length 36–58 μ; breadth 20–24 μ. (Tab. 3, fig. 2.) Samples 18, 19.

Netrium *Näg.*

22. *N. digitus* (Ehrenb.) Itzigs. & Rothe. (W. & G. S. West, Monogr. Brit. Desm., Vol. I, 1904, p. 64, Pl. VI, figs. 14–16.) Several of the specimens measured are considerably smaller than in the typical form namely 92–126 μ long, 33–44 μ broad and 15–20 μ broad near the apices. Samples 2, 19, 22, 25, 35, 39, 41, 66, 68, 69, 70.

Geographical Distribution.—England; Wales; Scotland; Ireland; Generally distributed in Europe; Faeroes; India; Ceylon; Siam; Java; Central China; Japan; Australia; New Zealand; Azores; United States; British Guiana; Brazil; Portuguese East Africa; South Africa.

23. *N. oblongum* (De Bary) Lütkem. var. *cylindricum* W. & G. S. West. (W. & G. S. West, Monogr. Brit. Desm., Vol. I, 1904, p. 67, Pl. V, fig. 7.) Sample 25.

Geographical Distribution.—England; Wales; Scotland; Italy; Somaliland; Japan; South Africa.

Order: Desmidiales.
Fam.: Desmidiaceae.
Subfam.: Saccodermae.

Gonatozygon *De Bary*

24. *G. monotaenium* De Bary. (W. & G. S. West, Monogr. Brit. Desm., Vol. I, 1904, p. 30, Pl. I, figs. 1–7; Pl. V, fig. 5.) Sample 20.

Geographical Distribution.—England; Wales; Scotland; Ireland; France; Germany; Austria; Hungary; Sweden; Faeroes; N. Russia; Greenland; India; Ceylon; Siam; Sumatra; West, Central and East Africa; W. Indies; United States; Brazil (var.); South Africa.

Subfam.: Placodermae.

Penium *Bréb.*

25. *P. barbaricum* spec. nova, affinis *P. margaritaceo* (Ehrenb.) Bréb., sed granulis membranae diffuse (neque in seriebus longitudinalibus) dispositis, membranaque achroa differt.

This species superficially resembles *P. margaritaceum* (Ehrenb.) Bréb. (W. & G. S. West, Monogr. Brit. Desm., Vol. I, 1904, p. 83, Pl. VIII, figs. 32–35); but the cell wall is colourless and furnished with numerous scattered granules. Cells of medium size, about 3·2–6·3 times longer than their diameter, with a distinct median constriction, apices rounded. Length 70–144 μ; breadth 18–23 μ. (Tab. 3, fig. 6.) Samples 20, 47, 48.

26. *Penium* species ad *P. cruciferum* (De Bary) Wittr. Cellulae cum *P. crucifero* valde congruentes praeterquam quod paulo minores sunt neque ullae costae in chromatophora visae sunt. Zygospora inventa est sed *P. cruciferi* zygospora adhuc ignoratur.

This comes very near *P. cruciferum* (De Bary) Wittr. (W. & G. S. West, Monogr. Brit. Desm., Vol. I, 1904, p. 100, Pl. X, figs. 18–19), but the cells are slightly smaller and no ridges were observed in the chloroplasts. A zygospore was found, but the zygospore of *P. cruciferum* has hitherto been unknown. The cells are very small, about 1·7–2·2 times longer than their diameter; ellipsoid-subcylindrical with a slight median constriction, apices rounded; cell wall smooth and colourless; each chloroplast with a central pyrenoid. Zygospore subquadrate, sides concave; cell wall straw-coloured. Length 12–13 μ; breadth 6–7 μ; diameter of zygospore 12–14 μ. (Tab. 3, figs. 16–17.) Sample 35.

27. *P. cucurbitinum* Biss. (W. & G. S. West, Monogr. Brit. Desm., Vol. I, 1904, p. 94, Pl. IX, figs. 13, 14.) Sample 39.

Geographical Distribution.—England; Wales; Scotland; Ireland; Japan; South Africa.

28. *P. cucurbitinum* f. *botesii* f. nova, affinis *P. cucurbitino* formae *minori* West, sed cellulis multo minoribus, apice hebetato, punctis in 8 series longitudinales ordinatis differt.

This species somewhat resembles *P. cucurbitinum* f. *minor* West (W. & G. S. West, Monogr. Brit. Desm., Vol. I, 1904, p. 95, Pl. IX, fig. 16); but the cells are much smaller, with the apices truncate; cell wall punctate, punctae arranged in about eight longitudinal rows. Cells small, about twice as long as broad, with a slight median constriction; chloroplasts with about four longitudinal ridges. Length 24–28 μ; breadth 11–14 μ; breadth of isthmus 7–10 μ. (Tab. 3, fig. 15.) Sample 27.

Named after Mr. P. W. Botes of Moddernek, Nylstroom.

29. *P. curtum* Bréb. (W. & G. S. West, Monogr. Brit. Desm., Vol. I, 1904, p. 97, Pl. X, figs. 21, 22.) Samples 7, 11, 32.

Geographical Distribution.—England; Wales; Scotland; Ireland; France; Germany; Austria; Italy; Norway; Sweden; Greenland; Spitzbergen; Nova Zembla; Franz-Joseph Land; India; Burma; Siam; West Africa; Madagascar; West Indies; United States; South Africa.

30. *P. curtum* var. *waterbergense* var. nova, a typo speciei membrana ad apices cellulae haud incrassata et sculptura membranae differt.

This agrees somewhat with the typical form, but differs in the absence of a cell wall thickening at the apices and in the sculpture of the cell wall. Cell wall punctate, punctae arranged in about eight longitudinal rows. Length 27–33 μ; breadth 18–20 μ; breadth of isthmus 16–18 μ. (Tab. 3, fig. 9.) Samples 30, 51, 52, 53, 54, 58, 64.

31. *P. jenneri* Ralfs. (W. & G. S. West, Monogr. Brit. Desm., Vol. I, 1904, p. 77, Pl. VII, figs. 20, 21.) Sample 2.
Geographical Distribution.—England; Scotland; Ireland; Germany; Austria; Norway; Sweden; Poland; South Africa.

32. *P. libellula* (Focke) Nordst. var. *schweickerdtii* var. nova, affinis *P. libellulae* var. *interrupto* W. et G. S. West, sed cellulis 3·8–5-plo longioribus quam latioribus chromatophoris constrictis neque interruptis differt.

This approaches *P. libellula* var. *interruptum* W. & G. S. West (W. & G. S. West, Monogr. Brit. Desm., Vol. I, 1904, p. 74, Pl. VII, figs. 9–10); but the cells are shorter, and 3·8–5 times longer than their diameter; chloroplasts constricted and not transversely divided. Cells of medium size, unconstricted, fusiform, apices slightly truncately rounded; chloroplasts with about 10 longitudinal ridges. Length 68–108 μ; breadth 16–25 μ; breadth near apices 6–12 μ. (Tab. 3, fig. 7.) Samples 2, 24, 25, 27, 32, 39, 41.
Named after Prof. Dr. H. G. Schweickerdt, Head of the Department of General Botany, University of Pretoria.

33. *P. margaritaceum* (Ehrenb.) Bréb. (W. & G. S. West, Monogr. Brit. Desm., Vol. I, 1904, p. 83, Pl. VIII, figs. 32–35.) Tab. 3, fig. 3 shows a form during cell-division in which the cell wall is furnished with longitudinal rows of granules, but the granules are irregularly scattered at the apices. Samples 13, 18, 19.

Geographical Distribution.—England; Wales; Scotland; Ireland; France; Germany; Austria; Poland; Hungary; Italy; Portugal; Norway; Sweden; Finland; Lapland in Russia; Faeroes; Greenland; Spitzbergen; Java; New Zealand; East Africa; Azores; United States; Ecuador; Switzerland; South Africa.

34. *P. margaritaceum* var. *brevior* var. nova, a typo speciei cellulis valde latioribus fere 3·6–4·8-plo longioribus quam latioribus differt.

Length in proportion to breadth differs from the typical form; cells 3·6–4·8 times longer than their diameter. Length 84–96 μ; breadth 20–23 μ. (Tab. 3, fig. 5.) Samples 13, 19.

35. *P. margaritaceum* var. *incognitum* var. nova, a typo speciei semicullulis ad basim tumidis similiter ac apud genus *Pleurotaenium* Näg. differt.

This variety differs from the typical form in possessing a basal inflation in each semicell similar to that found in the genus *Pleurotaenium* Näg. Cells large, 7·7–8·4 times longer than their diameter, apices rounded; cell wall yellowish-brown and furnished with longitudinal rows of granules; chloroplasts with about 10 longitudinal plates (or ridges) and showing a median interruption. Length of cell 184–185 μ; breadth at base of semicell 22 μ, near basal inflation 18–18·5 μ, at middle of semicell 22–24 μ, at apices 16–17 μ. (Tab. 3, fig. 4.) Sample 13.

36. *P. mesianum* spec. nova, affinis *P. phymatosporo* Nordst., sed membrana cellulae granulata haud striata differt.

This is near *P. phymatosporum* Nordst. (W. & G. S. West, Monogr. Brit. Desm., Vol. I, 1904, p. 91, Pl. VI, figs. 9–11); but the cell wall is furnished with minute granules and is not striated. Cells small, more than twice as long as broad, with a slight median constriction; apices truncately rounded; cell wall conspicuously covered with granules; each chloroplast has a single pyrenoid. Length 32–42 μ; breadth 13–16 μ. (Tab. 3, figs. 10–13.) Samples 3, 24, 27.

Named after the late Prof. Dr. M. G. Mes, formerly Head of the Department of Plant Physiology and Biochemistry, University of Pretoria.

37. *P. navicula* Bréb. (W. & G. S. West, Monogr. Brit. Desm., Vol. I, 1904, p. 75, Pl. VII, figs. 12–15, 19.) Specimens were found with length 33–80 μ; breadth 12–20 μ; breadth of apices 6–8 μ. Samples 2, 51, 52, 53, 54, 57, 58, 63.

Geographical Distribution.—England; Wales; Scotland; Ireland; France; Germany; Austria; Hungary; Norway; Sweden; Italy; Russia; Lapland; Faeroes; Greenland; India; Ceylon; Singapore; United States; Brazil; First record for South Africa.

38. *P. phymatosporum* Nordst. (W. & G. S. West, Monogr. Brit. Desm., Vol. I, 1904, p. 91, Pl. VI, figs. 9–11.) Sample 2.

Geographical Distribution.—England; Scotland; Ireland; France; Austria; Italy; Argentina; Trinidad (?); Japan; Switzerland; Nantucket, U.S.A.; South Africa.

39. *P. pseudorufescens* spec. nova, affinis *P. rufescenti* Cleve, sed cellula dimidio minore differt; constrictura media haud visa, membrana achroa.

Near *P. rufescens* Cleve (W. & G. S. West, Monogr. Brit. Desm., Vol. I, 1904, p. 99, Pl. VI, figs. 12, 13); but the cells are only about half the size of those of Cleve's species; no trace of a constriction in the middle of the cell was found; cell wall colourless. Cells small, about 2·5–3 times longer than their diameter, slightly attenuated towards the apices, which are rounded; cell wall smooth. Length 28–30 μ; breadth 9–12 μ. (Tab. 3, fig. 14.) Sample 24.

40. *P. subcucurbitinum* spec. nova, affinis *P. cucurbitino* Biss., sed cellulis fere duplo longioribus quam latioribus, apice hebetato nec non sculptura membranae differt.

Near *P. cucurbitinum* Biss. (W. & G. S. West, Monogr. Brit. Desm., Vol. I, 1904, p. 94, Pl. IX, figs. 13, 14); however the cells are about two times longer than their diameter, and the apices are truncate; it also differs in the sculpture of the cell wall. Cells small, subcylindrical, with a slight median constriction, gradually attenuated towards the apices; cell wall furnished with granules. Length 39 μ; breadth 20 μ. (Tab. 3, fig. 8.) Sample 39.

Closterium *Nitzsch*

41. *C. abruptum* West var. *westiorum* var. nova, affinis *C. abrupto* var. *breviori* W. et G. S. West, sed cellulis minus arcuatis vel rectis et polis hebetatis differt.

Near *C. abruptum* var. *brevius* W. & G. S. West (W. & G. S. West, Monogr. Brit. Desm., Vol. I, 1904, p. 160, Pl. XX, figs. 11, 12); but the cells are less curved or practically straight and the apices are more truncate. Cells about 5·9–6·5 times longer than their diameter. Chloroplasts with about eight ridges and a central series of 2–3 pyrenoids. Length 75–84 μ; breadth 12–13 μ; breadth of apices 6–7 μ. (Tab. 6, figs. 9, 10). Sample 2.

Named after Messrs. W. & G. S. West.

42. *C. acerosum* (Schrank) Ehrenb. var. *waterbergense* var. nova, affinis *C. aceroso* var. *elongato* Bréb., sed cellulis valde minoribus et polis hebetatis differt.

This comes near *C. acerosum* var. *elongatum* Bréb. (W. & G. S. West, Monogr. Brit. Desm., Vol. I, 1904, p. 148, Pl. XVIII, fig. 1); but differs in having smaller cells with truncate apices. Cells of medium size, about 9·5–10·5 times longer than their diameter, inner margin slightly concave, gradually attenuated towards the apices, which are truncate; cell wall yellowish-brown, striated, about 40 striae visible across the cell; chloroplasts with about eight ridges and a central series of 10–15 pyrenoids; terminal vacuoles with a number of moving granules. Length 398–432 μ; breadth 41–42 μ; breadth of apices 8 μ. (Tab. 4, figs. 6, 7.) Sample 54.

43. *C. acutum* (Lyngb.) Bréb. var. *linea* (Perty) W. & G. S. West f. *minor* f. nova, a varietate *linea* (Perty) W. et G. S. West cellulis multo brevioribus (nec angustioribus) differt.

The cells are considerably shorter than those in var. *linea* (Perty) W. & G. S. West (W. & G. S. West, Monogr. Brit. Desm., Vol. I, 1904, p. 178, Pl. XXIII, fig. 15), but have the same breadth. Cells 16–18 times longer than their diameter; chloroplasts with 3–4 pyrenoids; terminal vacuoles with one moving granule. Length 64–88 μ; breadth 4–5 μ. (Tab. 6, fig. 22.) Sample 22.

44. *C. atomicum* spec. nova, affinis *C. striolata* Ehrenb., sed differt cellulis multo minoribus, margine ventrali medio incrassato, membrana cellulae 14 striis quae videre possunt ornata.

This is near *C. striolatum* Ehrenb. (W. & G. S. West, Monogr. Brit. Desm., Vol. I, 1904, p. 122, Pl. XIII, figs. 7–16); but the cells are considerably smaller, inner margin tumid in the median part. Cells of medium size, 7–8 times longer than their diameter, curved, inner margin concave and tumid in the median portion, gradually attenuated towards the apices, which are slightly truncate; cell wall yellowish-brown, about 14 striae visible across the cell. Length 160–196 μ; breadth 22·5–26 μ; breadth of apices 9–12 μ. (Tab. 5, fig. 16.) Sample 3.

45. *C. barbaricum* spec. nova, affinis *C. parvulo* Näg., sed cellulis minus arcuatis, polis hebetatis, vacuolis terminalibus granulo singulo se moventi praeditis differt.

This species differs from *C. parvulum* Näg. (W. & G. S. West, Monogr. Brit. Desm., Vol. I, 1904, p. 133, Pl. XV, figs. 9–12) in the cells having a smaller curvature, the apices being acute and in the terminal vacuoles containing only one moving granule. Cells small, 7–9 times longer than their diameter, curved, inner margin concave, not tumid, gradually attenuated towards the apices, which are truncately-rounded; cell wall smooth and colourless; chloroplasts with six ridges and six pyrenoids. Figs. 5 and 6 show cells which have atypical apices, possibly owing to the fixative used. Length 66–92·5 μ; breadth 8–11·5 μ. (Tab. 6, figs. 4–6.) Sample 2.

46. *C. boyanum* spec. nova, affinis *C. stellenboschensi* Hodgetts, sed cellulis maioribus, minusque arcuatis et apice utroque poro praedito differt.

Near *C. stellenboschense* Hodgetts (W. J. Hodgetts, Trans. Roy. Soc. of S.A., Vol. XIII, 1926, p. 74, fig. 8); but the cells are larger and less curved, there is a pore at each apex. Cells of medium size, 7·3–7·4 times longer than their diameter, inner margin concave, slightly tumid in the median portion, gradually attenuated towards the apices, which are slightly acutely-rounded; cell wall smooth, straw-coloured or yellowish, with a pore at each apex; chloroplasts with about six ridges and a central series of five pyrenoids; terminal vacuoles large, with a number of moving granules. Length 167–174 μ; breadth 23–24 μ. (Tab. 5, fig. 13.) Samples 57, 58, 64.

47. *C. caffrorum* spec. nova, affinis *C. cynthiae* De Not, sed cellulis multo minus arcuatis et polis hebetatis differt. Membrana cellulae plus minusve 9 striis quae videri possunt ornata.

This species is near *C. cynthia* De Not (W. & G. S. West, Monogr. Brit. Desm., Vol. I, 1904, p. 113, Pl. XI, figs. 1–3); but the cells are less curved and have truncate apices. Cells small, curved, inner margin concave, apices truncate; chloroplasts with six ridges and a central series of about four pyrenoids; cell wall yellowish-brown and striated, about nine striae being visible across the cell; terminal vacuoles with a single moving granule. Length 100–104 μ; breadth 13·5–14 μ. (Tab. 8, fig. 4.) Sample 64.

48. *C. calosporum* Wittr. var. *minor* var. nova, a typo speciei cellulis multo minoribus ad apices hebeto-rotundatis et minus curvatis differt.

These specimens differ from the typical form (W. & G. S. West, Monogr. Brit. Desm., Vol. I, 1904, p. 138, Pl. XVI, figs. 1–4) in having smaller cells, truncately-rounded apices and a smaller curvature. Cells about 7·7 times longer than their diameter; chloroplasts with a single series of about two pyrenoids. Length 54 μ; breadth 7 μ. (Tab. 6, fig. 20.) Sample 3.

49. *C. ceratium* Perty var. *angustum* var. nova, a typo speciei cellulis multo angustioribus (cellula 49·1–56·1-plo longior quam latior) differt. Formae intermediae non visae.

Cells narrower than in the typical form (W. & G. S. West, Monogr. Brit. Desm., Vol. I, 1904, p. 176, Pl. XXIII, figs. 6–8). Cells about 49·1–56·1 times longer than their diameter; straight for almost the whole length of the cell; chloroplasts with 11–12 pyrenoids. Length 123·5–124 μ; breadth 2·2–2·5 μ. (Tab. 6, fig. 14.) Sample 3.

50. *C. cornu* Ehrenb. var. *minor* var. nova, a typo cellulis multo minoribus et poli minus acutis differt. Formae intermediae non visae.

Cells considerably smaller than in the typical form (W. & G. S. West, Monogr. Brit. Desm., Vol. I, 1904, p. 157, Pl. XX, figs. 1–5), being about 13–17 times longer than their diameter; chloroplasts with about three pyrenoids. Length 64–74 μ; breadth 4–5 μ; breadth of apices 2·2–2·6 μ. (Tab. 6, fig. 23.) Sample 22.

51. *C. cornu* var. *angustum* var. nova, a var. *minori* Claassen cellulis paulo angustioribus et polis multo acutioribus differt.

Near var. *minor* Claassen; but the cells are narrower and the apices more acute. Cells 12·5–19 times longer than their diameter. Length 75–77 μ; breadth 3·4–4 μ. (Tab. 6, fig. 24.) Sample 2.

52. *C. cymbellaeformis* spec. nova. Nulla affinitate obvia. Cellulae naviculares, margo ventralis tenuiter convexus apices hebetati, et membrana cellulae paulo incrassata.

Cells of medium size, boat-shaped, inner margin slightly convex, apices truncate with a slightly thickened cell wall; cell wall smooth and colourless; chloroplasts with about 10 ridges and a central series of four pyrenoids; subterminal vacuoles large, with a number of moving granules. Length 168–171·5 μ; breadth 28–29 μ; breadth of apices 8–10 μ. (Tab. 5, fig. 15.) Sample 2.

53. *C. cynthia* De Not var. *waterbergense* var. nova, differt a typo speciei cellulis minus arcuatis pauloque latioribus, polis minus acutis et membrana plus minusve 13 striis quae videri possunt ornata.

The cells are less curved than in the typical form (W. & G. S. West, Monogr. Brit. Desm., Vol. I, 1904, p. 113, Pl. XI, figs. 1–3); they are slightly broader, the apices are less acute and the cell wall has about 13 striae visible across the cell. Inner margin slightly tumid; cell wall yellowish-brown; chloroplasts with about six ridges and a central series of four pyrenoids; terminal vacuoles with one moving granule. Length 115–119 μ; breadth 18·5–20 μ. (Tab. 8, fig. 3.) Sample 64.

54. *C. decorum Breb.* var. *minor* var. nova, differt a typo cellulis multo minoribus et membrana striis 23–24 quae videri possunt disposita.

Cells considerably smaller than in the typical form (W. & G. S. West, Monogr. Brit. Desm., Vol. I, 1904, p. 184, Pl. XVII, figs. 7, 8; Pl. XXVIII, figs. 1–3) and the cell wall with more striae. Cells of medium size, 10–14·6 times longer than their diameter, curvature somewhat variable, inner margin concave, slightly but broadly tumid in the median portion, gradually attenuated towards the apices, which are truncate; cell wall straw-coloured or yellowish-brown; each chloroplast with a central series of 6–11 pyrenoids. Length 176–292 μ; breadth 17–20 μ; breadth of apices 4–5 μ. (Tab. 5, fig. 12.) Samples 3, 63.

55. *C. ehrenbergii* Menegh. (W. & G. S. West, Monogr. Brit. Desm., Vol. I, 1904, p. 143, Pl. XVII, figs. 1–4.) Sample 42.

Geographical Distribution.—England; Wales; Scotland; Ireland; France; Belgium; Germany; Austria and Galicia; Bosnia in Hungary; Italy; Portugal; Norway; Sweden; Denmark; North, Central and South Russia; Faeroes; Central China; Japan; India; Siam; Samoa; New Zealand; Central Africa (var.); East Africa; United States; West Indies; Brazil; Uruguay; Patagonia; South Africa.

56. *C. ehrenbergii* var. *minutissimum* var. nova, affinis *C. ehrenbergii* Menegh., sed cellulis fere 5–7-plo minoribus, polis plus hebetatis, vacuolis terminalibus granulo singulo se moventi praeditis differt.

The cells are about 5–7 times smaller than in the typical form, the apices are more truncate and the terminal vacuoles have a single moving granule. Cells small, 4·1–4·8 times longer than their diameter; cell wall smooth and yellowish; chloroplasts with about six ridges and a central series of five pyrenoids. Length 75·5–77 μ; breadth 16 μ; breadth of apices 5–6 μ. (Tab. 6, fig. 21.) Sample 39.

57. *C. gracile* Breb. var. *brevius* var. nova, a typo speciei cellulis multo latioribus differt. Formae intermediae non visae.

Cells broader than in the typical form (W. & G. S. West, Monogr. Brit. Desm., Vol. I, 1904, p. 166, Pl. XXI, figs. 8–12). Cells about 11–15·5 times longer than their diameter; chloroplasts with about six ridges and a single series of 4–6 pyrenoids; terminal vacuoles with one moving granule. Length 112–136 μ; breadth 8·5–12 μ; breadth of apices 2·2–3 μ. (Tab. 6, fig. 12.) Samples 51, 52, 54, 64.

58. *C. incurvum* Breb. var. *elaboratum* var. nova, a typo speciei cellulis minus arcuatis, polis minus acutis, vacuolis terminalibus singulo se moventi granulo praeditis differt.

This differs from the typical form (W. & G. S. West, Monogr. Brit. Desm., Vol. I, 1904, p. 136, Pl. XV, figs. 28–30) in the smaller curvature of the cells, in the terminal vacuoles containing only one moving granule and in the less acute apices. Cells 4·5–6 times longer than their diameter, apices acutely rounded; chloroplasts with six ridges and a central series of two pyrenoids. Length 51–52 μ; breadth 8·5–11 μ; breadth of apices 1·5–2·5 μ. (Tab. 6, fig. 19.) Samples 58, 59, 63.

59. *C. insolitum* spec. nova. Nulla affinitate obvia. Cellulae solum plus minusve 2·8-plo longiores quam latiores, valide arcuatae ad apices rotundatae, membrana achroa glabraque. Chromatophora binis seriebus 2 vel 3 pyrenoidorum ornata.

This differs from other species of *Closterium* in the cells being rather broad in proportion to their length. Cells of medium size, about 2·8 times longer than their diameter, strongly curved, apices rounded; cell wall smooth and colourless; chloroplasts with about four ridges and two series of 2–3 pyrenoids each. Length 124 μ; breadth 44 μ. (Tab. 8, fig. 5.) Sample 39.

60. *C. intermedium* Ralfs var. *mesianum* var. nova, affinis *C. intermedio* var. *hibernico* West, sed polis non valde arcuatis, membrana cellulae glabra et achroa (quae colore caret) differt.

This superficially resembles *C. intermedium* var. *hibernicum* West (W. & G. S. West, Monogr. Brit. Desm., Vol. I, 1904, p. 126, Pl. XIV, fig. 6); but the poles are less incurved; cell wall smooth and colourless and the cells are considerably longer than in West's variety. Cells of medium size, about 19–22·7 times longer than their diameter, moderately curved, inner margin straight in the median portion, gradually attenuated towards the apices, which are truncate and slightly incurved; chloroplasts with about eight ridges, and 12–13 pyrenoids in one axile series; terminal vacuoles with a number of moving granules. Length 324–364 μ; breadth 16–18 μ; breadth of apices 4 μ. (Tab. 4, fig. 3.) Sample 44.

Named after the late Prof. Dr. M. G. Mes, formerly Head of the Department of Plant Physiology and Biochemistry, University of Pretoria.

61. *C. jenneri* Ralfs. (W. & G. S. West, Monogr. Brit. Desm., Vol. I, 1904, p. 134, Pl. XV, figs. 23–25.) Sample 27.

Geographical Distribution.—England; Wales; Scotland; Ireland; France; Germany; Galicia; Hungary; Italy; Spain; Norway; Sweden; Bornholm; North and South Russia; Faeroes; Nova Zembla; Greenland; Siam; Java; Central and East Africa; Azores; United States; Brazil; Switzerland; South Africa.

62. *C. jenneri* var. *dubitabilis* var. nova, affinis *C. jenneri* var. *robusto* G. S. West, sed cellulis minus arcuatis differt.

This is near *C. jenneri* var. *robustum* G. S. West (W. & G. S. West, Monogr. Brit. Desm., Vol. I, 1904, p. 136, Pl. XV, figs. 26, 27); but the cells are less curved than in West's variety. Cells small, about 6·5–7·4 times longer than their diameter; cell wall smooth and yellowish-brown; chloroplasts with about six ridges and five pyrenoids; terminal vacuoles with 1–2 moving granules. Length 84–86 μ; breadth 11·5–13 μ; breadth of apices 5–6 μ. (Tab. 6, fig. 7.) Sample 3.

63. *C. kranskopense* spec. nova. Prima facie forma cellulae plus minusve *C. cornu* Ehrenb. congruens, sed cellulis 7-plo maioribus, membrana luteo-brunea apicem versus incrassata et plus minusve 60 striis disposita differt.

The shape of the cell (low magnification) agrees with that of *C. cornu* Ehrenb. (W. & G. S. West, Monogr. Brit. Desm., Vol. I, 1904, p. 157, Pl. XX, figs. 1–5); but the cells are about seven times as large as those in Ehrenberg's species; the cell wall is yellowish-brown and striated; with about 60 striae visible across the cell, and the cell walls are thickened at the apices. Cells large, 15–16 times longer than their diameter, moderately curved, inner margin concave, gradually attenuated towards the apices, which are truncately rounded; cell wall with a distinct thickening at each apex; chloroplasts with about six ridges, and a central series of 14–23 pyrenoids; terminal vacuoles with a number of moving granules. Length 765–854 μ; breadth 52–54·5 μ. (Tab. 4, figs. 4, 5.) Sample 61.

64. *C. kützingii* Bréb. var. *transvaalense* var. nova, a typo speciei differt quod cellulae media pars multo longius est incrassata.

This differs from the typical form (W. & G. S. West, Monogr. Brit. Desm., Vol. I, 1904, p. 186, Pl. XXV, figs. 6–11) in the cells being tumid in the median part for a greater distance. Cells about 24 times longer than their diameter; about 16 striae visible across the cell. Length 336 μ; breadth 14 μ; breadth of apices 3 μ. (Tab. 6, fig. 1.) Sample 3.

65. *C. malinvernianum* De Not. (W. & G. S. West, Monogr. Brit. Desm., Vol. I, 1904, p. 145, Pl. XVII, figs. 5, 6.) Up to 68 striae visible across the cell. Figs. 9–11 are cells soon after division. (Tab. 4, figs. 8–11.) Samples 51, 52, 53, 54, 57, 58.

Geographical Distribution.—England; Scotland; Ireland; Austria and Galicia; Italy; Spain; Norway; Sweden; South Africa.

66. *C. moniliferum* (Bory) Ehrenb. (W. & G. S. West, Monogr. Brit. Desm., Vol. I, 1904, p. 142, Pl. XVI, figs. 15, 16.) Samples 4, 6, 14.

Geographical Distribution.—England; Wales; Scotland; Ireland; France; Belgium; Germany; Switzerland; Galicia in Austria; Hungary and Bosnia; Italy; Portugal; Norway; Sweden; Denmark; Bornholm; North and South Russia; Poland; Faeroes; Iceland; China; Japan; Ceylon; New Zealand; Central Africa; United States; Brazil; Argentina; Uruguay; Patagonia; South Africa.

67. *C. moniliferum* var. *epithemioides* var. nova, a typo speciei margine ventrali medio minus tumido, membrana straminea et cellulis plerumque paulo minoribus differt.

Inner margin slightly but broadly tumid; cell wall straw-coloured; cells usually somewhat smaller than in the typical form. Cells 5–7 times longer than their diameter; chloroplasts with about eight ridges and a central series of 5–6 pyrenoids. Length 184–240 μ; breadth 34–38 μ; breadth of apices 6–8 μ. (Tab. 5, fig. 14.) Samples 13, 14, 15.

68. *C. parvulum* Näg. (W. & G. S. West, Monogr. Brit. Desm., Vol. I, 1904, p. 133, Pl. XV, figs. 9–12.) Sample 32.

Geographical Distribution.—England; Wales; Scotland; Ireland; France; Germany; Switzerland; Austria; Galicia; Hungary; Spain; Norway; Sweden; Denmark; Finland; North, South and Central Russia; Nova Zembla; Greenland; Siberia; Japan; Ceylon; Siam; Sumatra; Java; Samoa; Australia; Central and East Africa; United States; Brazil; Ecuador; Patagonia; South Africa.

69. *C. parvulum* var. *minor* var. nova, a typo speciei cellulis multo minoribus et apicibus aliquanto plus hebetatis differt. Formae intermediae haud visae.

Cells smaller and apices more truncate than in the typical form. Length 76–76·5 μ; breadth 7–8 μ; breadth of apices 3–4 μ. (Tab. 6, fig. 8.) Sample 3.

70. *C. peracerosum* Gay var. *elegans* G. S. West. (W. & G. S. West, Monogr. Brit. Desm., Vol. I, 1904, p. 155, Pl. XIX, figs. 12, 13.) Ventral margin in the median portion of the cell slightly more tumid than in the typical form, and the cells are shorter. Length 134–172 μ; breadth 9–15 μ. (Tab. 6, fig. 11.) Samples 13, 14, 15. *Geographical Distribution.*—England; First record for South Africa.

71. *C. praelongum* Bréb. forma *brevior* West. (W. & G. S. West, Monogr. Brit. Desm., Vol. I, 1904, p. 165, Pl. XXI, figs. 3–5.) Cell wall yellowish and punctate. Sample 6.

Geographical Distribution.—England; Scotland; Ireland; Portugal; Sweden; New Zealand; South Africa.

72. *C. pritchardianum* Arch. (W. & G. S. West, Monogr. Brit. Desm., Vol. I, 1904, p. 172, Pl. XXII, figs. 6–14.) These specimens are generally larger than the typical form. Length 496–825 μ; breadth 48–58 μ; breadth of apices 5–7 μ. Samples 6, 42.

Geographical Distribution.—England; Scotland; Ireland; France; Germany; Austria and Galicia; Italy; Norway; Sweden; North Russia; China; Brazil; Argentina; Switzerland; South Africa.

73. *C. pseudoleibleinii* spec. nova, affinis *C. leibleinii* Kütz., sed differt èt cellulis non tantopere curvatis èt polis hebetatis èt quod tumor in medio margine ventrali minor est. Membrana cellulae iuxta ante apices in marginibus ventrali dorsalique incrassata.

This species comes near *C. leibleinii* Kütz. (W. & G. S. West, Monogr. Brit. Desm., Vol. I, 1904, p. 141, Pl. XVI, figs. 9–14); but the cells are less curved, with truncate apices and the ventral margin less tumid; the cell wall has an annular thickening at each apex. Cells of medium size, about 10·5 times longer than their diameter; cell wall smooth and yellowish-brown; the chloroplast has about six ridges and a central series of 6–8 pyrenoids; terminal vacuoles with one large moving granule. Length 231·5 μ; breadth 21·5 μ; breadth of apices 8·5 μ. (Tab. 5, fig. 8.) Sample 24.

74. *C. pseudolunula* spec. nova, affinis *C. lunulae* (Müll.) Nitzsch, sed apicibus cellulae hebetatis et minus recurvatis, etiam cellulis angustioribus differt.

Near *C. lunula* (Müll.) Nitzsch (W. & G. S. West, Monogr. Brit. Desm., Vol. I, 1904, p. 150, Pl. XVIII, figs. 8, 9), but the apices of the cells are truncate and less recurved and the cells are narrower and shorter. Cells of medium size, about 7–8 times longer than their diameter, straight, inner margin fairly straight or slightly tumid in the median part of the cell, gradually attenuated towards the apices, which are truncately rounded; cell wall smooth and colourless; each chloroplast with about 10 ridges and numerous scattered pyrenoids; terminal vacuoles large, with a number of moving granules. Length 372–412 μ; breadth 51·5–58 μ; breadth of apices 14–16 μ. (Tab. 4, fig. 1.) Samples 34, 35.

75. *C. ralfsii* Bréb. var. *subralfsii* var. nova, affinis *C. ralfsii* var. *hybrido* Rabenh., sed differt et cellulis minus arcuatis, et quod margo ventralis in media cellula incrassatus non est; et membrana 25–30 striis, chromatophoraque 11–16 pyrenoidibus minoribus instructa differt.

Near *C. ralfsii* var. *hybridum* Rabenh. (W. & G. S. West, Monogr. Brit. Desm., Vol. I, 1904, p. 183, Pl. XXIV, figs. 8–13); but the cells are less curved, and are without a median inflation; 25–30 striae visible across the cell; chloroplasts with a median series of 11–16 small pyrenoids. Cells of medium size, 9–13 times longer than their diameter, apices truncately rounded; cell wall yellowish-brown; chloroplasts with about six ridges; terminal vacuoles with a number of moving granules. Length 314–424 μ; breadth 34–38 μ; breadth of apices 8–10 μ. (Tab. 5, fig. 1.) Samples 34, 35.

76. *C. ralfsii* var. *glentigianum* var. nova, affinis var. *subralfsii* Claassen, sed membrana cellulae 32–34 striis et chromatophora 5–7 pyrenoidibus magnis instructa differt.

Cell wall with 32–34 striae across the cell; chloroplasts with a series of 5–7 large pyrenoids. Apices slightly obliquely-rounded. Length 322–344 μ; breadth 35–36 μ; breadth of apices 9–10 μ. (Tab. 5, fig. 2.) Sample 46.

77. *C. ralfsii* var. *minor* var. nova, a typo speciei cellulis multo minoribus differt. Membrana cellulae 21–23 striis et chromatophora 10–12 pyrenoidibus instructa. Formae intermediae haud visae.

Cells considerably smaller than in the typical form. Cells of medium size, 7–10 times longer than their diameter, moderately curved, inner margin concave. Cell wall yellowish-brown, striated, 21–23 striae visible across the cell; chloroplasts with 10–12 pyrenoids. Length 202–264 μ; breadth 26–32 μ; breadth of apices 8–10 μ. (Tab. 5, figs. 4–5.) Sample 3.

78. *C. ralfsii* var. *nodosum* var. nova, affinis *C. ralfsii* var. *hybrido* Rabenh. sec. Fukushima et Fujisawa, sed differt et polis leviter capitatis et quod plus minusve 18 striis, quae videri possunt, membrana distincta est.

This is near *C. ralfsii* var. *hybridum* Rabenh. sec. Fukushima & Fujisawa (H. Fukushima and the late K. Fujisawa, Desmids Flora of Oze. Reprinted from Scientific Researches of the Ozegahara Moor. Tokyo, 1954, p. 596, Pl. I, figs. L–M.); but the apices are slightly clavate and about 18 striae are visible across the cell. Cells of medium size, 8·6–8·8 times longer than their diameter, curved, inner margin concave and

straight in the median portion, gradually attenuated towards the apices; cell wall yellowish-brown; chloroplasts with about 12 ridges and a central series of 12–13 pyrenoids; terminal vacuoles with a number of moving granules. Length 306–310 μ; breadth 35–35·5 μ; breadth of apices 12–12·5 μ. (Tab. 5, fig. 3.) Sample 42.

79. *C. rostratum* Ehrenb. (W. & G. S. West, Monogr. Brit. Desm., Vol. I, 1904, p. 188, Pl. XXVI, figs. 1–5.) Some specimens are slightly narrower (17 μ) than in the typical form. Sample 21.

Geographical Distribution.—England; Wales; Scotland; Ireland; France; Germany; Austria and Galicia; Hungary; Italy; Portugal; Norway; Sweden; Bornholm; Poland; North, Central and South Russia; Finland; Faeroes; Iceland; Nova Zembla; Greenland; Siberia; Japan; Ceylon (form); East Africa; United States; Brazil; Ecuador; Paraguay; Switzerland; South Africa.

80. *C. schweickerdtii* spec. nova, affinis *C. stellenboschensi* Hodgetts, sed cellulis multo maioribus et magis arcuatis, polisque acutioribus differt. Apex uterque poro vacuolaeque terminales paucis granulis se moventibus praeditae.

Near *C. stellenboschense* Hodgetts (W. J. Hodgetts, Trans. Roy. Soc. of S.A., Vol. XIII, 1926, p. 74, fig. 8); but the cells are considerably larger, the apices are more acute and the cells are strongly curved; each apex furnished with a pore; terminal vacuoles with a number of moving granules. Cells of medium size, about 6·8–8·5 times longer than their diameter, inner margin tumid in the median portion, gradually attenuated towards the apices, which are somewhat acute; cell wall smooth and colourless; chloroplasts with about eight ridges and a series of 5–9 pyrenoids; terminal vacuoles with 4–5 large moving granules. Length 170–186 μ; breadth 20–26 μ. (Tab. 5, fig. 18.) Samples 42, 44.

Named after Prof. Dr. H. G. Schweickerdt, Head of the Department of General Botany, University of Pretoria.

81. *C. spetsbergense* Borge var. *subafricanum* var. nova, affinis *C. spetsbergensi* var. *africano* Fritsch et Rich, sed differt et forma polorum et quod membrana cellulae striata est. Cellulae multo minores sunt; striarum dispositio cum *C. pritchardiano* Arch. valde congruit.

This is near *C. spetsbergense* Borge var. *africanum* Fritsch & Rich (F. E. Fritsch & F. Rich, Trans. Roy. Soc. of S.A., Vol. XVIII, 1930, p. 57, fig. 16C–G); but the shape of the apices is different, the cells are considerably smaller, and the cell wall is striated; striae similar to those found in *C. pritchardianum* Arch. Cells about 7–11 times longer than their diameter; cell wall yellowish or yellowish-brown, 35–40 striae visible across the cell; striae composed of fine punctae; chloroplasts with 6–10 ridges, and a central series of 4–9 pyrenoids; terminal vacuoles with a number of moving granules. Length 238–394 μ; breadth 34–52 μ; breadth of apices 5–6 μ. (Tab. 4, fig. 2.) Samples 13, 14, 15.

82. *C. striolatum* Ehrenb. var. *nylstromicum* var. nova, a typo cellulis brevioribus et 7–8-plo longioribus quam latioribus, polis plus hebetatis, membrana ad apices leviter incrassata et 13–18 striis praedita differt.

This differs from the typical form (W. & G. S. West, Monogr. Brit. Desm., Vol. I, 1904, p. 122, Pl. XIII, figs. 7–16) in having shorter cells (about 7–8 times longer than their diameter) with blunter apices; cell wall slightly thickened at the apices, yellowish-brown, with 13–18 striae visible across the cell. Length 192–220 μ; breadth 26–32 μ; breadth of apices 12 μ. (Tab. 5, fig. 9.) Samples 34, 35.

83. *C. striolatum* var. *subnylstromicum* var. nova, affinis var. *nylstromico* Claassen, sed differt striis inter se plus approximatis, plus minusve 19 in membrana dispositis, quae ad apices est incrassata.

Cells of medium size, about 7·5 times longer than their diameter, slightly curved, gradually attenuated towards the apices, which are obtusely-rounded; cell wall yellowish-brown, striated, with 19 striae visible across the cell; each chloroplast with 6–7 pyrenoids; terminal vacuoles with one large moving granule. Length 191 μ; breadth 25 μ; breadth of apices 12 μ. (Tab. 5, fig. 10.) Sample 54.

84. *C. subdecorum* spec. nova, affinis *C. decoro* Bréb., sed cellulis multo minoribus, margine ventrali pro parte maiore tumido, membrana striis carenti differt.

This is near *C. decorum* Bréb. (W. & G. S. West, Monogr. Brit. Desm., Vol. I, 1904, p. 184, Pl. XVII, figs. 7, 8; Pl. XXVIII, figs. 1–3), but the cells are considerably smaller, the inner margin of the cell is tumid for a longer distance and the cell wall is smooth. Cells of medium size, about 10·4–10·7 times longer than their diameter, curved, gradually attenuated towards the apices, which are obtusely-rounded; cell wall smooth and colourless; chloroplasts with a central series of three pyrenoids; terminal vacuoles with a number of moving granules. Length 203·5–208 μ; breadth of apices 3·5–4 μ. (Tab. 5, fig. 11.) Sample 2.

85. *C. sublagoense* spec. nova, affinis *C. lagoensi* Nordst., sed cellulis angustioribus, forma poli et margine ventrali medio incrassato differt.

This species is near *C. lagoense* Nordst. (W. & G. S. West, Monogr. Brit. Desm., Vol. I, 1904, p. 114, Pl. XI, figs. 5–7); but the cells are narrower, the shape of the apices differs and the inner margin is tumid in the median portion. Cells small, 7·5–8·5 times longer than their diameter, strongly curved, gradually attenuated towards the apices, which are somewhat acutely rounded; cell wall yellowish, striated, with about 11 striae visible across the cell. Length 160–168 μ; breadth 20–21 μ. (Tab. 5, fig. 17.) Sample 12.

86. *C. subsiliqua* spec. nova, affinis *C. siliqua* W. et G. S. West, sed cellulis haud curvatis, margine ventrali recto, vel in media cellula leviter incrassata differt.

This somewhat resembles *C. siliqua* W. & G. S. West (W. & G. S. West, Monogr. Brit. Desm., Vol. I, 1904, p. 154, Pl. XIX, figs. 6–8); but the cells are straight. Cells of medium size, about 8–9·4 times longer than their diameter, more or less straight, inner margin straight or slightly tumid in the median portion, gradually attenuated towards the apices, which are slightly acute, and recurved in some specimens; cell wall smooth and colourless or straw-coloured; chloroplasts with about 10 ridges and a central series of 7–11 pyrenoids; terminal vacuoles with one large moving granule. Length 227–264 μ; breadth 26–32 μ; breadth of apices 3–6 μ. (Tab. 5, fig. 7.) Samples 13, 14, 15.

87. *C. truncatum* spec. nova. Nulla affinitate notata. Cellulae plus minusve 6·2-plo longiores quam latiores. Margo ventralis in media cellula leviter incrassatus; poli hebetati. Membrana glabra, subflava et apicem versus leviter incrassata.

Cells of medium size, about 6·2 times longer than their diameter, slightly curved, inner margin somewhat concave, with the median portion slightly tumid, gradually attenuated towards the apices, which are truncate; cell wall smooth, yellowish and with a thickening at the apices; chloroplasts with about 10 ridges and a central series of four pyrenoids; terminal vacuoles large, with a number of moving granules. Length 224–225·5 μ; breadth 36 μ; breadth of apices 8–8·5 μ. (Tab. 5, fig. 6.) Sample 21.

88. *C. tumidum* Johnson. (W. & G. S. West, Monogr. Brit. Desm., Vol. I, 1904, p. 156, Pl. XIX, figs. 15–18.) Cells up to 9·9–13 times longer than their diameter. Length 102–114 μ; breadth 9–10·5 μ; breadth of apices 2·5–3 μ. (Tab. 6, fig. 15.) Sample 9.

Geographical Distribution.—England; Wales; Scotland; Norway; Nova Zembla; Siam; Celebes; Samoa; United States; Brazil; Paraguay; Patagonia; Japan; South Africa.

89. *C. tumidum* var. *angustum* var. nova, a typo speciei cellulis multo angustioribus et minus arcuatis differt. Cellula 15·5–22-plo longior quam latior.

Cells narrower than in the typical form, being about 15·5–22 times longer than their diameter, and less curved. Chloroplasts with about nine pyrenoids. Length 108–132 μ; breadth 6–8 μ; breadth of apices 1–1·3 μ. (Tab. 6, fig. 13.) Sample 3.

90. *C. venus* Kütz. (W. & G. S. West, Monogr. Brit. Desm., Vol. I, 1904, p. 137, Pl. XV, figs. 15–20.) Samples 4, 9, 21.

Geographical Distribution.—England; Wales; Scotland; Ireland; France; Germany; Austria and Galicia; Hungary; Italy; Norway; Sweden; North Russia; Faeroes; Nova Zembla; Greenland; Siberia; Central China; Japan; Ceylon; Burma; Siam; New Zealand; Central Africa; Azores; United States; Brazil; Patagonia; Switzerland; South Africa.

91. *C. venus* var. *inflatum* var. nova, a typo speciei differt quod margo ventralis cellulae media in parte leviter inflatus, membranaque achroa est vel subflava.

This differs from the typical form in that the inner margin is slightly tumid. Cells about 6·8–7·1 times longer than their diameter; cell wall smooth and colourless or yellowish; each chloroplast with a central series of two pyrenoids; terminal vacuoles with 1–2 moving granules. Length 68–70 μ; breadth 9–10 μ; breadth of apices 1·5–2·5μ. (Tab. 6, figs. 16–18.) Samples 6, 11.

92. *C. warmbadianum* spec. nova, affinis *C. spinosporo* Hodgetts, sed cellulis brevioribus latioribusque, membrana cellulae ad apices non incrassata sed in medio margine ventrali leviter incrassata differt. Vacuolae terminales granulis paucis globosis seque moventibus praeditae.

Near *C. spinosporum* Hodgetts (W. J. Hodgetts, Trans. Roy. Soc. of S.A., Vol. XIII, 1926, p. 72, fig. 7A–B); but the cells are shorter and broader, the inner margin is slightly tumid in the median portion. The apices are without a cell wall thickening; and the terminal vacuoles are large, with a number of spherical moving granules. Cells small, 6·5–8 times longer than their diameter, curved, gradually attenuated towards the apices, which are slightly acutely rounded; cell wall smooth and colourless; chloroplasts with about eight ridges and 2–5 pyrenoids. Length 104–118 μ; breadth 14–18 μ. (Tab. 6, fig. 2.) Samples 51, 52, 53, 54.

93. *C. warmbadianum* var. *porulosum* var. nova, a typo speciei differt quod apex uterque poro est praeditis et vacuolae terminales granula aliquot maiora, elongata, se moventia habent.

Each apex with a pore in the cell wall; terminal vacuoles with a number of large oblong moving granules. Cell wall colourless or yellowish-brown; chloroplasts with about six ridges and 3–4 pyrenoids. Length 104–120 μ; breadth 12–15 μ. (Tab. 6, fig. 3.) Samples 58, 63, 64.

Pleurotaenium *Näg.*

94. *P. caffrorum* spec. nova, affinis *P. basiundato* W. et G. S. West, sed semicellulis iuxta tumorem basalem unica undulatione praeditis differt.

This comes near *P. basiundatum* W. & G. S. West (W. & G. S. West, Algae of Madagascar, Trans. Linn. Soc. London, Ser. 2, Bot., Vol. V, 1895–1901, Pl. 5, fig. 35); but the semicells have a single small undulation above the basal inflation. Cells of medium size, cylindrical, 25·8–30 times longer than their diameter; semicells gradually attenuated from base to apex, with a distinct basal inflation and a smaller undulation above it; apices obtusely rounded, bordered by a ring of tubercles, eight in number (four visible across the apex); cell wall punctate. Length 400–482 μ; breadth at base of semicells 20 μ, at middle of semicells 15·5–16 μ, at apices 14·4–15 μ. (Tab. 7, fig. 6.) Sample 20.

95. *P. ehrenbergii* (Bréb.) De Bary. (W. & G. S. West, Monogr. Brit. Desm., Vol. I, 1904, p. 205, Pl. XXIX, figs. 9–11; Pl. XXX, fig. 1.) Sample 20.

Geographical Distribution.—England; Wales; Scotland; Ireland; France; Germany; Austria and Galicia; Hungary; Italy; Norway; Denmark; Bornholm; Poland; North Russia; Nova Zembla; Siberia; Central China; India; Ceylon; Java; Sumatra; Samoa; Australia; New Zealand; Madagascar; East and West Africa; United States; Brazil; Patagonia; Japan; Switzerland; South Africa.

96. *P. ehrenbergii* var. *waterbergense* var. nova, affinis *P. ehrenbergii* var. *undulato* Schaarschm., sed differt et membrana luteo-fulva et quod semicellulis iuxta tumorem basalem undulatio aut deest aut vix perspici potest.

Near *P. ehrenbergii* var. *undulatum* Schaarschm. (W. & G. S. West, The Freshwater Algae of Ceylon, Trans. Linn. Soc. London, Ser. 2, Vol. VI, 1901–1902, Pl. 18, fig. 28); but the semicells are without or with one very slight undulation above the basal inflation, cell wall yellowish-brown. Cells of medium size, 10·7–11·4 times longer than their diameter; semicells gradually attenuated from base to apex; apices bordered by a ring of pear-shaped tubercles, 4–8 in number (three or five visible across the apex); cell wall punctate. Length 416–428 μ; breadth at base of semicells 36·4–41 μ, at middle of semicells 36–36·5 μ, at apices 26–29 μ. (Tab. 7, figs. 7, 8.) Sample 22.

97. *P. maximum* (Reinsch) Lund. (W. & G. S. West, Monogr. Brit. Desm., Vol. I, 1904, p. 213, Pl. XXXI, figs. 1, 2.) Sample 61.

Geographical Distribution.—Wales; Scotland; France; Germany; Italy; Austria and Galicia; Hungary; Sweden; Japan (var.); Ceylon; Siam; Abyssinia; West Africa; Brazil; Ecuador (var.); Paraguay; Uruguay; South Africa.

98. *Pleurotaenium* species ad *P. ovatum* Nordst. Cells of medium size: 3·8–4 times longer than their diameter; semicells tumid, a little broader at the middle than at the base, attenuated from the middle to the apices, without a basal inflation; apices with one or two rings of tubercles, outer ring with 6–10 tubercles (4–6 visible across the apex) and the inner ring with 6–8 (3–4 visible across the cell); cell wall punctate. Length 313–356 μ; breadth 83–90 μ; breadth of isthmus 44–60 μ; breadth of apices 25–28 μ. (Tab. 8, figs. 1, 2.) Samples 20, 42.

Since only the description of *P. ovatum* Nordst. was available, it is impossible to decide with certainty whether these specimens really belong to Nordstedt's species.

99. *P. pseudoehrenbergii* spec. nova, affinis *P. ehrenbergii* (Bréb.) De Bary, sed membrana glabra, apice utrinque tuberculo uno ornato, cellula iuxta tumorem basalem vix undulata differt.

This species is near *P. ehrenbergii* (Bréb.) De Bary (W. & G. S. West, Monogr. Brit. Desm., Vol. I, 1904, p. 205, Pl. XXIX, figs. 9–11; Pl. XXX, fig. 1); but the undulation above the basal inflation is very slight, there is one tubercle on each side of the apex, and the cell wall is smooth. Cells of medium size, subcylindrical, 12·4–12·5 times longer than their diameter; semicells with one distinct basal inflation and a small undulation above it, gradually attenuated towards the apices or slightly tumid and then gradually attenuated towards the apices; apices truncate, furnished with two tubercles. Length 408–448 μ; breadth at base of semicells 31–34 μ, at middle of semicells 32–36 μ, at apices 24–26·5 μ. (Tab. 7, fig. 2.) Sample 24.

100. *P. trabecula* (Ehrenb.) Näg. var. *angustum* var. nova, a typo speciei cellulis multo angustioribus differt. Cellulae plus minusve 25·5–28·3-plo longiores quam latiores.

Cells narrower in proportion to their length than in the typical form (W. & G. S. West, Monogr. Brit. Desm., Vol. I, 1904, p. 209, Pl. XXX, figs. 11–13); cells 25·5–28·3 times longer than their diameter. Apices obtusely rounded, without tubercles; cell wall punctate. Length 514–568 μ; breadth at base of semicell 24–24·5 μ, at middle of semicell 20–21 μ, at the apices 16–19 μ. (Tab. 7, figs. 3–5.) Samples, 59, 60.

101. *P. trabecula* var. *barbaricum* var. nova, affinis *P. trabeculae* var. *recto* (Delp.) W. et G. S. West, sed differt quod apex cellulae circulo 6 tuberculorum instructus est, cellulae 14·9–16-plo longioribus quam latioribus, at quam variationis *rectum* (Delp.) W. et G. S. West paulo latiores sunt.

This closely resembles *P. trabecula* var. *rectum* (Delp.) W. & G. S. West (W. & G. S. West, Monogr. Brit. Desm., Vol. I, 1904, p. 212, Pl. XXX, figs. 9, 10); but the cells are a little broader and the apices tuberculate. Cells of medium size, rather narrow and subcylindrical; semicells somewhat variable in shape, attenuated from base to apex or slightly tumid and then gradually attenuated to the apices, with a distinct basal inflation and one small undulation immediately above it; apices truncate, bordered by a ring of conical tubercles, six in number (four visible across the apex); cell wall smooth. Length 402·5–420 μ; breadth at base of semicells 27–28 μ, at middle of semicells 23–27 μ, at apices 18–20 μ. (Tab. 7, fig. 1.) Sample 61.

102. *P. trabecula* var. *brevis* var. nova, a typo speciei cellulis valde brevioribus et apicibus tuberculis ornatis differt.

Cells shorter than in the typical form, apices with one tubercle. Length 359 μ; breadth at base of semicell 28–28·5 μ, at middle of semicells 26–27·5 μ, and at apices 19–20 μ. (Tab. 7, fig. 10.) Sample 35.

103. *P. trochiscum* W. & G. S. West var. *galpinii* var. nova, a typo cellulis multo brevioribus et 7·2–8-plo longioribus quam latioribus, margine apicali circulo tuberculorum fere 8 ornato differt.

The cells are considerably shorter than in the typical form (W. & G. S. West, North American Desmidieae, Trans. Linn. Soc. London, Ser. 2, Bot., Vol. V, 1895–1901, Pl. 13, figs. 4, 5), and are about 7·2–8 times longer than their diameter; apices bordered by a ring of tubercles, about eight in number (five visible across the apex). Length 252–264 μ; breadth at base of semicell 33–35 μ, at middle of semicell 30–32 μ, at apices 20–23 μ. (Tab. 8, fig. 7.) Sample 71.

Named after Mr. E. A. Galpin of Mosdene, Naboomspruit.

104. *P. truncatum* (Bréb.) Näg. var. *mattiei* var. nova, affinis *P. truncato* var. *granulato* West, sed cellulis multo brevioribus, semicellulis media in parte minus tumidis, margine apicali tuberculis paucioribus ornato differt.

Near *P. truncatum* var. *granulatum* West (W. & G. S. West, Monogr. Brit. Desm., Vol. I, 1904, p. 205, Pl. XXIX, figs. 7, 8); but the cells are much shorter, they are less tumid in the median part of the semicells and the apical margin has fewer tubercles. Cells small, about 7–7·2 times longer than their diameter; semicells with one basal inflation, slightly tumid in the middle of the semicells; apices bordered by a ring of tubercles, 2–4 in number (2–3 visible across the apex); cell wall punctate. Length 272 μ; breadth at base of semicell 36 μ, at middle of semicell 38–39 μ, at apices 26–28 μ. (Tab. 8, fig. 6.) Sample 21.

105. *P. westiorum* spec. nova, affinis *P. monilifero* W. et G. S. West, sed apicibus cellulae multo latioribus (modo non tam latis quam ad semicellulae basim) differt.

This is near *P. moniliferum* W. & G. S. West (W. & G. S. West, The Freshwater Algae of Madagascar, Trans. Linn. Soc. London, Ser. 2, Bot., Vol. V, 1895–1901, Pl. 5, fig. 32); but with broader apices (about as broad as at the base of the semicells). Cells large, 16–16·5 times longer than their diameter; semicells slightly tumid in the middle, with a slight basal inflation and two smaller undulations above it; apices truncate, and bordered by a ring of pear-shaped tubercles, 24 in number (13 visible across the apex); cell wall smooth. Length 796–800 μ; breadth at base of semicells 48–50 μ, near base of semicells 44–46 μ, at middle of semicells 48–50 μ, near apices 40–44·5 μ, at apices 44–47 μ. (Tab. 7, fig. 9.) Sample 1.

Named after Messrs. W. & G. S. West.

Tetmemorus *Ralfs*

106. *T. laevis* (Kütz.) Ralfs. (W. & G. S. West, Monogr. Brit. Desm., Vol. I, 1904, p. 222, Pl. XXXII, figs. 11–16.) Sample 2.

Geographical Distribution.—England; Wales; Scotland; Ireland; France; Belgium; Germany; Austria and Galicia; Italy; Norway; Sweden; Denmark; Bornholm; North and South Russia; Nova Zembla; Greenland; Singapore; Australia; New Zealand; Sandwich Islands; Azores; Dominica and Trinidad; West India; Brazil; Japan; Central Africa; Switzerland; United States; South Africa.

Euastrum *Ehrenberg*

107. *E. ansatum* Ralfs. (W. & G. S. West, Monogr. Brit. Desm., Vol. II, 1905, p. 27, Pl. XXXVI, figs. 10–13.) Fig. 8 shows a cell with dividing pyrenoids. (Tab. 9, fig. 8.) Samples, 3, 25, 34, 35, 36, 54, 56.

Geographical Distribution.—England; Wales; Scotland; Ireland; France; Belgium; Germany; Austria and Galicia; Hungary; Italy; Norway; Sweden; Denmark; Bornholm; Finland; North and South Russia; Faeroes; Iceland; Greenland; Central China; Japan; India; Ceylon; Burma (var.); Siam; Singapore; Sumatra; Java; Australia (form); New Zealand; Madagascar; East Africa; Azores; Sandwich Islands; United States; West Indies (var.); Brazil; Paraguay; Switzerland; South Africa.

108. *E. brasiliense* Borge var. *theronii* var. nova, affinis *E. brasiliensi* var. *africano* Fritsch et Rich, sed cellularum a latere visarum forma differt quoniam semicellulae gradatim a basi apicem versus in cuneum deplanantur, neque tuberculi apparent.

This variety closely resembles *E. brasiliense* var. *africanum* Fritsch & Rich (F. E. Fritsch & F. Rich, Trans. Roy. Soc. of S.A., Vol. XI—Part 4, 1924, p. 330, fig. 9); but the shape of its semicells differs in being gradually attenuated from base to apex when seen in lateral view and the cells are slightly smaller. Cells of medium size, about 3–3·4 times longer than broad, deeply constricted; sinus narrowly linear, open towards the extremity; semicells pyramidate, basal angles rounded, lower part of lateral margins convex, upper part slightly concave; apex truncate with rounded angles, median incision not very deep; semicells tumid above the isthmus. Side view of semicell elongate-pyramidate; cell wall punctate. Length 107–108 μ; breadth 32–35 μ; breadth of isthmus 16–18 μ; breadth of apex 22–23 μ. (Tab. 9, figs. 6, 7.) Sample 42.

Named after Mr. J. E. Theron of Rietfontein 288, Nylstroom.

109. *E. cuneatum* Jenner var. *minor* var. nova, cum typo speciei valde congruens, sed cellulis multo minoribus et incisura apicali multo angustiore bene distincta. Formae intermediae haud visae.

Cells much smaller than in the typical form (W. & G. S. West, Monogr. Brit. Desm., Vol. II, 1905, p. 25, Pl. XXXVI, fig. 9) and the apical incision is narrower. Cell wall finely punctate. Length 64–68 μ; breadth 25–27 μ; breadth of isthmus 9–12 μ; thickness 20 μ. (Tab. 9, figs. 13, 14.) Sample 3.

110. *E. denticulatum* (Kirchn.) Gay. (W. & G. S. West, Monogr. Brit. Desm., Vol. II, 1905, p. 56, Pl. XXXIX, figs. 1–4.) Sample 24.

Geographical Distribution.—England; Wales; Scotland; Ireland; France; Germany; Galicia and Austria; Norway; Sweden; Bornholm; Finland; North Russia (var.); Iceland; Greenland; Central China; Ceylon; Siam; Singapore; Java; Australia (var.); New Zealand; Madagascar (var.); East and Central Africa; Azores; United States; West Indies; Brazil (var.); South Africa.

111. *E. divaricatum* Lund. var. *transvaalense* var. nova, cum typo speciei plus minusve congruens, sed paulo major; lobus apicalis dentibus duobus parvis, lobis lateralis infimus dentibus 3 parvis munitus. A latere visus processus supra isthmum glaber singularisque, sed a vertice bipartitus videtur.

The cells are slightly larger than in the typical form (W. & G. S. West, Monogr. Brit. Desm.,Vol. II, 1905, p. 42, Pl. XXXVIII, figs. 3, 4). Lower lateral lobules with three teeth and upper lobules with two teeth each; protuberance in each semicell above the isthmus single in lateral view and bilobulate in vertical view. Length 52 μ; breadth 36 μ (with teeth 41 μ); breadth of isthmus 8–9 μ; breadth of apex 20 μ. (Tab. 24, figs. 1–3.) Sample 39.

112. *E. divergens* Joshua var. *subbifidum* var. nova, affinis *E. divergenti* var. *bifido* Schmidle, sed praecipue forma lobi polaris et cellulis multo minoribus differt.

This variety has a greater resemblance to var. *bifidum* Schmidle (W. Schmidle, Engler Botan. Jahrb., Vol. 26, 1899, p. 44, Taf. II, fig. 34) than to Joshua's species (W. Joshua, Burmese Desmidieae, Journ. Linn. Soc. Bot., Vol. XXI, p. 640, Pl. 23, figs. 8, 9). However, it differs from Schmidle's variety in having relatively smaller cells and in the shape of the polar lobes. Cells small, about 1·2 times longer than broad, deeply constricted; sinus narrowly linear; semicells deeply 3-lobed; granules above central inflation in concentric arrangement; lateral lobes semifusiform, ends truncate, upper part of lobes elongated, lobes ornate with granules; polar lobe quadrate in lower part and widening at the apex. Length 44–50 μ; breadth 36–42 μ; breadth of isthmus 10–12 μ; maximum breadth of polar lobe 20 μ. (Tab. 9, fig. 3.) Sample 20.

113. *E. divergens* var. *galpinii* var. nova, affinis *E. divergenti* var. *subbifido* Claassen, sed lobis lateralibus multo brevioribus latioribusque (quam prioris varietatis) et forma lobi polaris differt.

Upper part of lateral lobes shorter and broader than in var. *subbifidum* Claassen, and the shape of the polar lobe is different. Length 55 μ; breadth 48 μ (with spines 53 μ); breadth of isthmus 12 μ; maximum breadth of polar lobe 24 μ. (Tab. 29, fig. 3.) Sample 68.

Named after Mr. E. A. Galpin of Mosdene, Naboomspruit.

114. *E. dubitabilis* spec. nova, affinis *E. inermi* (Ralfs) Lund., sed discrepantia latitudinis ad basin et ad apicem multo minore bene distincta.

This species is near *E. inerme* (Ralfs) Lund. (W. & G. S. West, Monogr. Brit. Desm., Vol. II, 1905, p. 24, Pl. XXXVI, figs. 7, 8); but the apices are not very much narrower than the base of the semicells and the cells are smaller. Cells small, about 2·1–2·2 times longer than broad, deeply constricted, sinus narrowly linear; semicells truncate-pyramidate, basal angles rounded; upper part of lateral margins somewhat concave; apex convex with a narrow median incision. Cell wall smooth. Length 36·5–38 μ; breadth 16·5–18 μ; breadth of isthmus 7·5–8 μ; breadth of apex 12 μ. (Tab. 9, fig. 9.) Sample 24.

115. *E. elegans* (Bréb.) Kütz. var. *transvaalense* var. nova, affinis *E. eleganti* var. *madagascariensi* W. et G. S. West, sed forma apicis, incisura apicali multo angustiore, et tumore supra isthmum granulis 4 ornato bene distincta.

This is near *E. elegans* var. *madagascariense* W. & G. S. West (W. & G. S. West, The Freshwater Algae of Madagascar, Trans. Linn. Soc. London, Ser. 2, Vol. V, 1895–1901, Pl. 6, fig. 18); but differs in the shape of the apex, the apical incision is narrower and the protuberance above the isthmus contains four granules; the cells are slightly smaller than in Messrs. West's variety. Length 23–24 μ; breadth 16 μ; breadth of isthmus 3–4 μ; breadth of apex 6·5–8 μ. (Tab. 9, fig. 18.) Sample 20.

116. *E. galpinii* spec. nova, affinis *E. bidentato* Näg., sed lobo infimo laterali latiore quam lobo laterali supremo et margine apicali recto bene distincta.

Near *E. bidentatum* Näg. (W. & G. S. West, Monogr. Brit. Desm., Vol. II, 1905, p. 39, Pl. XXXVII, figs 16–19); but the semicells are broader at the lower lateral lobule than at the upper lateral lobule; apical margin straight. The protuberance in the centre above the isthmus has four granules, and there are a few granules within the lateral lobules and the apex. Length 38 μ; breadth 27 μ; breadth of isthmus 8 μ; breadth of apex 16 μ. (Tab. 29, fig. 1.) Sample 72.

117. *E. insulare* (Wittr.) Roy. (W. & G. S. West, Monogr. Brit. Desm., Vol. II, 1905, p. 68, Pl. XL, figs. 11–13.) Fig. 11 shows a cell during normal cell division and fig. 12 shows an abnormal one. (Tab. 9, figs. 10–12.) Samples 3, 24, 41.

Geographical Distribution.—England; Wales; Scotland; Ireland; Galicia in Austria; Norway; Sweden; Siam; United States; Japan; Switzerland; South Africa.

118. *E. obesum* Josh. (W. & G. S. West, Monogr. Brit. Desm., Vol. II, 1905, p. 29, Pl. XXXVI, figs. 16, 17.) Sample 52.

Geographical Distribution.—England; India; Burma; Singapore; Sumatra; Madagascar; South Africa.

119. *E. pseudovalidum* spec. nova, affinis *E. valido* W. et G. S. West, sed forma cellulae (praecipue ad basin semicellulae) haud multum sed plane differt. Dentes desunt.

Near *E. validum* W. & G. S. West (W. & G. S. West, Monogr. Brit Desm., Vol. II, 1905, p. 75, Pl. XL, figs. 21, 22); but differs in the shape of the basal part of the semicells, and in the absence of teeth. Cells small, about 1·5–1·6 times longer than broad, very deeply constricted, sinus narrowly linear; semicells truncate-pyramidate, lateral margins retuse, inferior angles inflated, superior angles somewhat acutely-rounded; apex broad, truncate-convex, emarginate. Semicells ovate in lateral view, and elliptic in vertical view. Cell wall smooth. Length 36–36·5 μ; breadth 22–23 μ; breadth of isthmus 8–9·5 μ; breadth of apex 14–16 μ; thickness 14 μ. (Tab. 9, figs. 15–17.) Sample 24.

120. *E. rostratum* Ralfs subsp. *umbonatum* W. & G. S. West var. *kranskopense* var. nova, affinis *E. rostrato* subsp. *umbonato* W. et G. S. West, sed sculptura membranae omnino diversa facile distinguenda.

The shape of the cells agrees with that of *E. rostratum* subsp. *umbonatum* W. & G. S. West (W. & G. S. West, The Freshwater Algae of Madagascar, Trans. Linn. Soc. London, Ser. 2, Vol. V, 1895–1901, Pl. 6, fig. 16); but the cell wall sculpture differs. Apex of polar lobe convex, slightly undulate, with a deep and slightly open median notch, a short spine at each outer angle, and a thickening of the cell wall at each angle and below the apical notch. Cell wall punctate, punctae in rows. Length 50–54 μ; breadth 30·5–32 μ; breadth of isthmus 9–10 μ; breadth of apex (without spines) 19–20 μ. (Tab. 9, figs. 4, 5.) Sample 61.

121. *E. spinulosum* Delponte subsp. *africanum* Nordst. (W. & G. S. West, The Freshwater Algae of Ceylon, Trans. Linn. Soc. London, Ser. 2, Vol. VI, 1901–1902, Pl. 19, fig. 21.) Interlobular incisions slightly deeper than in the typical form. The Doornfontein specimens are considerably larger than the Mosdene specimens.

	Doornfontein	*Mosdene*
Length.....	78–84 μ	60 μ
breadth.....	68–72 μ	56–60 μ
breadth of isthmus.....	16–18 μ	16 μ

(Tab. 9, fig. 1; Tab. 29, fig. 2.) Samples 20, 68, 72.

Geographical Distribution.—Ceylon; South Africa.

122. *E. spinulosum* subsp. *africanum* var. *transvaalense* var. nova, affinis var. *duplo-minori* W. et G. S. West, sed forma lobi polaris et incisuris interlobularibus minus profundis distinguenda.

This differs from var. *duplo-minor* W. & G. S. West (W. & G. S. West, The Freshwater Algae of Madagascar, Trans. Linn. Soc. London, Ser. 2, Bot., Vol. V, 1895–1901, Pl. 6, fig. 13) in the shape of the polar lobe, and in having shallower interlobular incisions and larger cells. Lobes more or less semicircular. Length 81–82 μ; breadth 62·5–64 μ; breadth of isthmus 15–15·5 μ. (Tab. 9, fig. 2.) Sample 6.

123. *E. schweickerdtii* spec. nova, ab omnibus generis speciebus distincta. Cellulae plus minusve tam longae quam latae. Semicellulae latae et obtuse pyramidales, margine apicali haud penitus inciso, supra isthmum dentes magno munitae; a latere visae planae et ovatae, a vertice ellipticae. Incisura apicali non profunda.

Cells small, about as long as broad, deeply constricted, sinus narrowly linear; semicells broad and flat, apical margin with a shallow median incision; with a tooth in the centre of each semicell above the isthmus. Side view of semicell flattened-ovate and oval in vertical view. Length 27 μ; breadth 27–28 μ; breadth of isthmus 7 μ; thickness 12·5–13 μ (with teeth 18 μ). (Tab. 9, figs. 19–21.) Sample 38.

Named after Prof. Dr. H. G. Schweickerdt, Head of the Department of General Botany, University of Pretoria.

Micrasterias *Ag.*

124. *M. americana* (Ehrenb.) Ralfs var. *transvaalensis* var. nova, affinis typo speciei, sed lobo polari bifido et minore differt.

This differs from the typical form (W. & G. S. West, Monogr. Brit. Desm., Vol. II, 1905, p. 117, Pl. LIII, figs. 4, 5; Pl. LIV, figs. 1–3) in the shape of the polar lobe. Polar lobe smaller than in the typical form, divided into two equal parts near the base (lateral view of semicell); apical margin with a slight median depression, angles produced into small divergent processes, each with a truncate-denticulate apex. Length 104–108 μ; breadth 80–82·5 μ; breadth of isthmus 17·5–18 μ; maximum breadth of polar lobe 34–35 μ. (Tab. 16, fig. 4.) Sample 19.

125. *M. apiculata* (Ehrenb.) Menegh. (W. & G. S. West, Monogr. Brit. Desm., Vol. II, 1905, p. 97, Pl. XLVII, figs. 1, 2.) Polar lobe less exserted than in the typical form, apical angles with one spine and in some specimens without spines (the typical form has a pair of diverging spines). Some specimens slightly smaller than in the type. Length 210–236 μ (with spines 238–252 μ); breadth 173–196 μ (with spines 186–217 μ); breadth of isthmus 30–35 μ; maximum breadth of polar lobe 64–80 μ. (Tab. 10, figs. 1–4.) Samples 25, 26, 38, 39.

Geographical Distribution.—England; France; Germany; Galicia in Austria; Italy; Sweden; Denmark; Bornholm; Finland; Poland; Russia; Japan; India; Burma; United States; First record for South Africa.

126. *M. crux-melitensis* (Ehrenb.) Hass. (W. & G. S. West, Monogr. Brit. Desm., Vol. II, 1905, p. 116, Pl. LIII, figs. 1–3.) The shape of the polar and lateral lobes differs slightly from those in the type. Cells slightly larger than in the typical form. Length 116–148 μ (with processes 128–168 μ); breadth 118–126 μ (with spines 128–140 μ); breadth of isthmus 20–23 μ; maximum breadth of polar lobe 60–80 μ. (Tab. 18, figs. 1–14; Tab. 19, figs. 1–11; Tab. 20, figs. 1–6; Tab. 21, figs. 1–4; Tab. 22, figs. 1–6; Tab. 23, fig. 1.) Samples 66, 73, 74.

Geographical Distribution.—England; Wales; Scotland; Ireland; France; Germany; Austria; Galicia; Hungary; Italy; Sweden; Denmark; Poland; North and South Russia; Japan; North India; Ceylon; Burma; Celebes; Madagascar (var.); Central Africa; United States; Brazil; Switzerland; South Africa.

127. *M. crux-melitensis* var. *evoluta* W. B. Turner. (W. & G. S. West, The Freshwater Algae of Madagascar, Trans. Linn. Soc. London, Ser. 2, Vol. V, 1895–1901, Pl. 6, fig. 1.) Apical margin of the polar lobe with four small teeth; the lateral lobes with more subdivisions than in the typical form. Length 98–124 μ (with processes 113–144 μ); breadth 101–116 μ (with teeth 111–128 μ); breadth of isthmus 17–22 μ; maximum breadth of polar lobe 36·5–45 μ. (Tab. 16, fig. 3; Tab. 17, fig. 1.) Samples 59, 74.

Geographical Distribution.—Madagascar; East India; South Africa.

128. *M. crux-melitensis* var. *transvaalensis* var. nova, typo speciei affinis, sed forma lobi polaris distincta et margine apicali paene recto quippe cui pars media leviter sit depressa.

This differs from the typical form in the shape of the polar lobe and in having an almost straight apical margin. Fig. 2 shows a cell shortly after division. Length 98–104 μ (with processes 110–113 μ); breadth 86–98 μ (with spines 96–105 μ); breadth of isthmus 16–19 μ; maximum breadth of polar lobe 40–44 μ. (Tab. 16, figs. 1, 2.) Samples 24, 39.

129. *M. denticulata* Bréb. var. *africana* var. nova, affinis *M. denticulatae* Bréb. var. *angustosinuatae* Gay, sed lobulo polari latiore et breviore, incisuris minus altis bene distinguenda.

This variety is near *M. denticulata* var. *angustosinuata* Gay (W. & G. S. West, Monogr. Brit. Desm., Vol. II, 1905, p. 108, Pl. L, fig. 5); but differs in having a shorter and broader polar lobe and shallower interlobular incisions. Some specimens with slightly exserted polar lobes (fig. 3). Length 234–248 μ; breadth 196–220 μ; breadth of isthmus 32–40 μ; maximum breadth of polar lobe 74–95 μ. (Tab. 11, figs. 1–4; Tab. 12, fig. 1.) Samples 24, 25, 36, 39.

130. *M. denticulata* var. *subnotata* West forma *cornuta* forma nova, affinis var. *subnotatae* West, sed differt quod in lobis polaribus ad incisuram media utrimque bini sunt processus, quibus singuli denticuli insunt.

This differs from West's variety (W. & G. S. West, Monogr. Brit. Desm., Vol. II, 1905, p. 108, Pl. L, fig. 7) in the polar lobe possessing a pair of processes on each side of the median notch; each process furnished with a small tooth. Cells slightly larger than var. *subnotata* West, and some lobules with more subdivisions. Length 208–256 μ; breadth 180–216 μ (fig. 3, 156 μ); breadth of isthmus 26–34 μ; maximum breadth of polar lobe 44–52 μ. (Tab. 12, fig. 2; Tab. 13, figs. 1–3.) Samples 35, 38.

131. *M. decemdentata* (Näg.) Arch. (Nägeli, Gatt. einzell. Algen, 1849, p. 123, Tab. VI, H, fig. 2; F. E. Fritsch & F. Rich, Trans. Roy. Soc. S. Afr., Vol. XI—Part 4, 1924, p. 337, fig. 13.)

Cell wall smooth or punctate. Length 76·5–80 μ; breadth 71·5–75·5 μ (with teeth 79–87 μ); breadth of isthmus 15–17 μ; maximum breadth of polar lobe 54–60·5 μ. (Tab. 16, fig. 5–7.) Samples 24, 39.

132. *M. decemdentata* var. *galpinii* var. nova. A typo speciei cellulis multo moniribus distincta. Formae intermediae haud visae.

Cells smaller than in the typical form; lateral angles of polar lobe acuminate. Length 48·5–52 μ; breadth 47–51 μ (with teeth 56–63 μ); breadth of isthmus 14–17 μ; maximum breadth of polar lobe 40–44 μ. (Tab. 17, figs. 4–7.) Samples 65, 66, 68, 70, 71, 74.

Named after Mr. E. A. Galpin of Mosdene, Naboomspruit.

133. *M. groenewaldii* spec. nova, affinis *M. confertae* Lund., sed lobi polaris forma differt et membranae tres processus supra isthmum sunt conspicui.

This species is near *M. conferta* Lund. (W. & G. S. West, Monogr. Brit. Desm., Vol. II, 1905, p. 88–89, Pl. XLIII, figs. 4–9); but differs in the shape of the polar lobe and each semicell has three processes above the isthmus. Cells fairly large, a little longer than broad, sub-elliptic, deeply constricted, sinus and interlobular incisions open outwards; semicells 5-lobed; polar lobe with convex sides in its lower half, upper half cuneate, apex with a median notch, apical margin with 4–5 spines on each side of the median hollow; superior lateral lobes slightly larger than inferior lateral lobes, each divided into two lobules, lobules again divided, the four ultimate divisions of each lobe being emarginate (or sometimes tridenticulate); the small lobule adjoining the polar lobe usually tridenticulate. Semicells with three projections across the base, the middle one immediately above the isthmus larger than the lateral ones. Cell wall furnished with numerous minute spines, arranged in subradiate rows. Cell in vertical view fusiform, poles acute, with three projections on each side towards the middle. Length 184–190 μ (with spines 197–203 μ); breadth 162–166 μ (with spines 170–174 μ); breadth of isthmus 29–33 μ; maximum breadth of polar lobe 61–68 μ. (Tab. 14, figs. 1–4.) Sample 46.

Named after Mr. L. J. Groenewald of Glentig, near Nylstroom.

134. *M. mahabuleshwarensis* Hobson var. *transvaalensis* var. nova, affinis *M. mahabuleshwarensi* var. *tetracero* W. et G. S. West, sed et forma lobi lateralis summi et dispositione dentium distincta. Margo lobi polaris duobus tantum processibus accessoriis est munitus, qui processibus *M. mahabuleshwarensis* simules sed multo breviores sunt.

Near *M. mahabuleshwarensis* var. *tetracerum* W. & G. S. West (W. & G. S. West, The Freshwater Algae of Madagascar, Trans. Linn. Soc. London, Ser. 2, Vol. V, 1895–1901, Pl. 6, figs. 2–4); but differs in the shape of the upper lateral lobule, and in the arrangement of the small spines; polar lobe with only two accessory denticulate processes like those in var. *wallichii* (Grun.) W. & G. S. West (W. & G. S. West, Monogr. Brit. Desm., Vol. II, 1905, p. 122, Pl. LIV, figs. 7, 8; Pl. LV, figs. 1–3); but the processes are considerably shorter. Apical margin of polar lobe furnished with four 3-pointed spines; each lobule of the lateral lobes furnished with singular or branched teeth; cell wall with a series of small teeth within the lateral lobes, across the lateral sides of the polar lobe and a few denticulations above the isthmus. Length 128 μ (with apical processes 148 μ); breadth 112 μ; breadth of isthmus 28 μ; maximum breadth of polar lobe 84 μ. (Tab. 17, fig. 2.) Samples 65, 71.

135. *M. nylstromica* spec. nova, ex affinitate *M. confertae* Lund., sed et forma lobi polaris et loborum superiorum-lateralium differt et quod dentibus est ornata.

This species somewhat resembles *M. conferta* Lund. (W. & G. S. West, Monogr. Brit. Desm., Vol. II, 1905, p. 88–89, Pl. XLIII, figs. 4–9); but differs in the shape of the polar and superior lateral lobes; cell wall furnished with small spines. Cells large, broadly elliptic, deeply constricted, sinus narrowly linear; semicells 5-lobed, the interlobular incisions being narrowly linear and not very deep; polar lobe sub-cuneate, lateral angles downwardly curved, apex concave with a median notch, with three spines on each side of the median notch, and a large curved spine on the apical margin close to each angle, and a smaller spine near the extremity; lateral lobes unequal, superior lateral lobes considerably larger than the inferior lateral lobes, each lateral lobe divided into two more or less similar lobules and each lobule furnished with four marginal spines except the lobule adjoining the polar lobe; this lobule consists of a lower part with four marginal spines, and an upper part which consists of a two-spined lower half and a three-spined upper half, the latter with the top spine upwardly curved to overlap the apical angle of the polar lobe. Cell wall strongly punctate and furnished

with numerous minute spines, arranged in subradiate rows within the polar and lateral lobes. Length 264–276 μ (with spines 278–292 μ); breadth 221–226 μ (with spines 233–241 μ); breadth of isthmus 42–43 μ; maximum breadth of polar lobe 102·5–108 μ. (Tab. 12, fig. 3; Tab. 13, fig. 4.) Samples 26, 39.

136. *M. pinnatifida* (Kütz.) Ralfs var. *transvaalensis* var. nova, affinis *M. pinnatifidae* var. *divisae* W. West formae *majori* Schmidle, sed differt et forma lobi polaris et quod tuberculi iuxta supra isthmum semicellulae desunt.

This differs from var. *divisa* W. West forma *major* Schmidle (W. Schmidle, Engler Botan. Jahrb., XXXII Bd., 1903, p. 73, Taf. II, fig. 7) in the shape of the polar lobes and in the absence of tubercles above the isthmus in each semicell. Length 108–116 μ; breadth 104–116 μ (with teeth 114–124 μ); breadth of isthmus 16–18 μ; maximum breadth of polar lobe 74–92 μ. (Tab. 23, figs. 2, 3.) Samples 72, 74.

137. *M. sol* (Ehrenb.) Kütz. (W. & G. S. West, Monogr. Brit. Desm., Vol. II, 1905, p. 95, Pl. XLVI, figs. 1, 2.) These specimens are slightly smaller than in the typical form. Length 146–152 μ; breadth 146–152 μ; breadth of isthmus 18–20 μ; maximum breadth of polar lobe 32–36 μ. (Tab. 15, fig. 6.) Samples 24, 25, 39.

Geographical Distribution.—England; Wales; Scotland; Ireland; France; Italy; Sweden; Denmark; United States; Jamaica; Brazil; First record for South Africa.

138. *M. tropica* Nordstedt var. *elongatissima* var. nova, affinis *M. tropicae* var. *elongatae* Schmidle, sed forma lobi polaris et dispositione dentium valde distincta. Cellula non duplo longior quam latior.

Near var. *elongata* Schmidle (W. Schmidle, Engler Botan Jahrb., Vol. 26, 1899, p. 48, Taf. III, fig. 13); but the proportion of length to breadth is not 2:1, and the shape of the polar lobe and the arrangement of the spines differ. Cells longer than in var. *elongata* Schmidle, polar lobes shorter and with a distinct constriction below the apex, apical margin concave, with the angles produced into short processes. Cell wall furnished with seven series of small spines within the lateral lobes, and with a number of spines within the lateral margins of the polar lobe. Length 112–128 μ; breadth 76–80 μ; breadth of isthmus 16 μ; maximum breadth of polar lobe 22–24 μ. (Tab. 17, fig. 3.) Sample 73.

139. *M. truncata* (Corda) Bréb. (W. & G. S. West, Monogr. Brit. Desm., Vol. II, 1905, p. 82, Pl. XLII, figs. 1–8; Pl. XLV, figs. 5, 6.) These specimens are usually slightly shorter than broad. Length 124–132 μ; breadth 124–138 μ; breadth of isthmus 22·5–27 μ; maximum breadth of polar lobe 82–100 μ (without spines 76–94 μ). (Tab. 15, figs. 1–3.) Samples 24, 25, 39.

Geographical Distribution.—England; Wales; Scotland; Ireland; France; Germany; Austria; Galicia; Hungary; Italy; Norway; Sweden; Denmark; Bornholm; Finland; Poland (form); North and South Russia; Faeroes; North India; Sandwich Islands; United States; Brazil; Switzerland; Japan; South Africa.

140. *M. truncata* var. *africana* Fritsch & Rich. (F. E. Fritsch & F. Rich, Trans. Roy. Soc. S. Afr., Vol. XI—Part 4, 1924, p. 338, fig. 14B and C.) Polar lobe somewhat variable in shape, cuneate or with subparallel sides in the lower portion and dilated in the upper portion. Length 134–152 μ; breadth 124–136 μ (without spines 120–131 μ); breadth of isthmus 25·5–26 μ; maximum breadth of polar lobe 62–67 μ. (Tab. 15, figs. 4, 5.) Samples 24, 39.
Geographical Distribution.—South Africa.

141. *M. truncata* var. *minor* var. nova. Cellulae varietatis quam typi speciei aliquanto minores sunt. Formae intermediae haud visae.

These specimens are considerably smaller than in the type. Lateral angles of polar lobe acuminate; cell wall punctate. Length 57·5–60 μ; breadth 56–60 μ (with spines 62–66 μ); breadth of isthmus 12·5–13 μ; maximum breadth of polar lobe 44–50 μ. (Tab. 17, fig. 8.) Sample 74.

Cosmarium *Corda*

142. *C. barbaricum* spec. nova, affinis *C. entochondro* W. et G. S. West, sed membrana cellulae glabra, sinu undulato et marginibus lateralibus magis undulatis facile distinguenda.

Near *C. entochondrum* W. & G. S. West (W. & G. S. West, Monogr. Brit. Desm., Vol. III, 1908, p. 193, Pl. LXXXVII, fig. 17); but the sides have more undulations, the sinus is undulate and the cell wall is smooth. Cells small, about as long as broad, deeply constricted, sinus narrow and slightly crenate; semicells semicircular, apex truncate, basal angles furnished with a spine, sides convex and with 3–5 undulations, apical margin smooth. Chloroplasts axile, each with two pyrenoids. Length 20–28 μ; breadth 19–28 μ; breadth of isthmus 9–9·5 μ; breadth of apex 10–14 μ. (Tab. 26, fig. 16.) Sample 24.

143. *C. binum* Nordst. (W. & G. S. West, Monogr. Brit. Desm., Vol. III, 1908, p. 246, Pl. LXXXVIII, figs. 10–14.) Some specimens with two horizontal series of granules below the conspicuous tumour immediately adjacent to the isthmus. (Tab. 27, figs. 1, 2.) Samples 7, 8, 12, 19, 20, 21, 23, 30, 35, 42, 43, 46, 47, 48, 51, 52, 53, 54, 57, 58, 65, 66, 72.

Geographical Distribution.—Scotland; Austria; Poland; Ceylon; Sumatra; Central Africa; Brazil; Australia; United States; South Africa.

144. *C. botesii* spec. nova, affinis *C. praemorso* Bréb., sed et dispositione granulorum omnino dissimili et membrana cellulae leviter undulata differt.

This species differs from *C. praemorsum* Bréb. (W. & G. S. West, Monogr. Brit. Desm., Vol. III, 1908, p. 196, Pl. LXXXIV, figs. 1–5) in the cell wall sculpture and in having slightly undulate margins. Cells of medium size, about 1·1–1·3 times as long as broad, deeply constricted, sinus narrowly linear; semicells semicircular, apex truncate, sides with 3–6 distinct and a number of obscure undulations, apical margin smooth or with about 3–4 undulations. Cell wall minutely punctate and with a number of large scattered grunules in the upper part of the semicell. Each chloroplast contains two pyrenoids. Length 46–49 μ; breadth 39–41 μ; breadth of isthmus 11–12·5 μ. (Tab. 27, figs. 3, 4.) Samples 24, 25.

Named after Mr. P. W. Botes of Moddernek, Nylstroom.

145. *C. caffrorum* spec. nova, affinis *C. subundulato* Wille, sed semicellulis paulo applanatis, membranis lateralibus solum undulatis, ore sinus denticulato, distinguitur.

This comes near *C. subundulatum* Wille (W. & G. S. West, Monogr. Brit. Desm., Vol. II, 1905, p. 151, Pl. LIX, figs. 13–15); but the semicells are slightly flattened, only the lateral margins are undulate and there is a small spine at each basal angle. Cells small, 1·2–1·3 times longer than broad, deeply constricted, sinus narrow, linear or slightly undulate; semicells truncate-pyramidate, basal angles furnished with a spine, sides convex with 3–4 undulations. Cell wall slightly thickened at the apex; chloroplasts axile, with two pyrenoids each. Length 33–42·5 μ; breadth 26–33 μ; breadth of isthmus 8·5–10·5 μ. (Tab. 25, figs. 7, 8.) Sample 24.

146. *C. connatum* Bréb. (W. & G. S. West, Monogr. Brit. Desm., Vol. III, 1908, p. 25, Pl. LXVII, figs. 15–17.) Sample 71.

Geographical Distribution.—England; Wales; Scotland; Ireland; France; Germany; Austria; Hungary; Galicia; Italy; Norway; Sweden; Denmark; Bornholm; Finland; South Russia; Japan; India; Burma; Singapore; Sumatra (form); Java; Central Africa; Sandwich Isles; United States; Guiana; Brazil; Switzerland; South Africa.

147. *C. connatum* var. *subellipticum* var. nova, affinis *C. connato* var. *truncato* West, sed semicellulis plus deplanatis et sinu aliquanto profundiore differt.

This is closely allied to *C. connatum* var. *truncatum* West (W. & G. S. West, Monogr. Brit. Desm., Vol. III, 1908, p. 26, Pl. LXVII, fig. 18); but differs in the character of the sinus and in having more flattened semicells. Cells of medium size, about 1·3–1·4 times as long as broad, deeply constricted, sinus widely open; semicells subelliptic with a flattened apex. Cell wall smooth and colourless and thickened at the apices. Chloroplasts with two pyrenoids each. Length 48–49·5 μ; breadth 37–40 μ; breadth of isthmus 14–17 μ; breadth of apex 14–17 μ. (Tab. 27, fig. 8.) Sample 24.

148. *C. contractum* Kirchn. (W. & G. S. West, Monogr. Brit. Desm., Vol. II, 1905, p. 170, Pl. LXI, figs. 23–25, 34.) Sample 24.

Geographical Distribution.—England; Wales; Scotland; Ireland; Germany; Galicia in Austria; Poland; Norway; India; Ceylon; Burma; Siam; Australia; Central Africa; Madagascar; United States; Patagonia; First record for South Africa.

149. *C. contractum* forma *jacobsenii* (Roy) W. & G. S. West. (W. & G. S. West, Monogr. Brit. Desm., Vol. II, 1905, p. 171, Pl. LXI, fig. 26.) Sample 71.

Geographical Distribution.—England; Scotland; Germany; Galicia in Austria; Norway; Sweden; Denmark; Bornholm; Central Africa; South Africa.

150. *C. contractum* var. *ellipsoideum* (Elv.) West. (W. & G. S. West, Monogr. Brit. Desm., Vol. II, 1905, p. 172, Pl. LXI, figs. 28, 35.) Sample 38.

Geographical Distribution.—England; Wales; Scotland; Ireland; Germany; Sweden; Finland; North Russia; Faeroes; Iceland; Australia; Switzerland; South Africa.

151. *C. contractum* var. *pseudogartanense* var. nova. Cellulae plus orbiculatae quam in typo, membrana marginis apicalis incrassata.

The semicells are more rounded than in the typical form; cell wall thickened at the apices and punctate. This is near var. *gartanense* W. & G. S. West (W. & G. S. West, Monogr. Brit. Desm., Vol. II, 1905, p. 173, Pl. LXI, fig. 27) in shape; but the apex is not retuse-emarginate. Length 47–48 μ; breadth 30–31 μ; breadth of isthmus 14 μ. (Tab. 24, fig. 6.) Sample 39.

152. *C. debaryi* Arch. var. *minor* var. nova. Differt a typo speciei cellulis dimidio minoribus et in medio margine apicali incisura minime profunda. Formae intermediae haud visae.

These specimens are about half the size of the typical form (W. & G. S. West, Monogr. Brit. Desm., Vol. III, 1908, p. 61, Pl. LXX, figs. 14–16; Pl. XCIII, fig. 2); apical margin with a shallow median incision. Length 46·5–48 μ; breadth 22·5–23 μ; breadth of isthmus 17 μ; thickness 18–20 μ. (Tab. 25, figs. 15, 16.) Sample 39.

153. *C. decoratum* W. & G. S. West. (W. & G. S. West, The Freshwater Algae of Madagascar, Trans. Linn. Soc. London, Ser. 2, Vol. V, 1895–1901, Pl. 7, fig. 21.) Cell wall sculpture only distinct in the median parts of the front, vertical and side views of the semicell as the semicell is not flat but ovate in side view and elliptic in vertical view. In this respect I do not agree with Messrs. West's figures. Samples 30, 46.

Geographical Distribution.—Madagascar; First record for South Africa.

154. *C. decoratum* var. *galpinii* var. nova, a typo speciei cellulis latioribus et membranae sculptura in media tantum parte conspicua differt.

Cells broader than in the type; cell wall sculpture only distinct in the median part of the semicell; cells about 1·2 times longer than broad. Length 84 μ; breadth 70 μ; breadth of isthmus 24 μ. (Tab. 29, fig. 11.) Sample 72.

Named after Mr. E. A. Galpin of Mosdene, Naboomspruit.

155. *C. decoratum* var. *waterbergense* var. nova, a typo speciei hiatibus, quibus sculptura membranae consistit, plus confertis—qui ornatus non per totam superficiem membranae apparet—et magnis granulis in ordinem circum marginem cellulae dispositis bene distincta.

Cell wall sculpture only distinct in the median part of the semicells and with a series of fairly large granules situated on the margins; cells about 1·4 times longer than broad. Length 73–82 μ; breadth 52–60·5 μ; breadth of isthmus 20–23·5 μ. (Tab. 24, fig. 11.) Sample 54.

156. *C. galpinii* spec. nova, affinis *C. isthmochondro* Nordst., sed differt quod margo apicalis duorum ordinum—quorum alter tantum a fronte videri potest—granulis quaternis magnis est ornatus; porro membranae sculptura toto caelo differt.

This species is near *C. isthmochondrum* Nordst. (W. & G. S. West, Monogr. Brit. Desm., Vol. III, 1908, p. 173, Pl. LXXXI, fig. 7); but differs in that the apical margin contains two series of four large granules each (only one series visible in front view of semicell), and in the cell wall sculpture. Cells small, about 1·2 times as long as broad, fairly deeply constricted, sinus narrowly linear; semicells truncate-semicircular, apical margin straight, with a series of four large granules; cell wall colourless or yellowish-brown, punctate, and with a number of scattered grunules. Vertical view more or less elliptic, with two circular series of granules in the centre, two series of four granules each on each side, and three smaller granules arranged in a triangle within the poles. Length 36 μ; breadth 29 μ; breadth of isthmus 14 μ; thickness 24 μ. (Tab. 29, figs. 5, 6.) Samples 65, 70.

Named after Mr. E. A. Galpin of Mosdene, Naboomspruit.

157. *C. granatum* Bréb. (W. & G. S. West, Monogr. Brit. Desm., Vol. II, 1905, p. 186, Pl. LXIII, figs. 1–4.) Sample 43.

Geographical Distribution.—England; Wales; Scotland; Ireland; France; Germany; Austria and Galicia; Poland; Hungary; Italy; Bosnia; Portugal; Norway; Sweden; Denmark; Bornholm; Finland; North and South Russia; Siberia; Faeroes: Iceland; Greenland; Spitzbergen; Nova Zembla; Afghanistan; Kordofan; India, Ceylon; Burma; Central China; New Zealand; Australia; West, Central and East Africa; Madagascar; United States; West Indies; Ecuador (var.); Brazil; Paraguay (var.); Argentina; Patagonia; Switzerland; South Africa.

158. *C. granatum* var. *africanum* Fritsch. (F. E. Fritsch & E. Stephens, Trans. Roy. Soc. of S. Afr., Vol. IX, 1921, p. 32, fig. 11C.) (Tab. 25, figs. 17, 18; Tab. 29, fig. 4.) Samples 39, 74.

Geographical Distribution.—South Africa; Switzerland.

159. *C. hammeri* Reinsch. var. *minor* var. nova, a typo speciei cellulis dimidio minoribus differt. Formae intermediae haud visae.

Cells less than half the size of the typical form (W. & G. S. West, Monogr. Brit. Desm., Vol. II, 1905, p. 181, Pl. LXII, figs. 20, 21); and about 1·3–1·6 times longer than broad. Length 16–19 μ; breadth 12 μ; breadth of isthmus 3–4 μ. (Tab. 24, fig. 13.) Sample 24.

160. *C. impressulum* Elfv. (W. & G. S. West, Monogr. Brit. Desm., Vol. III, 1908, p. 86, Pl. LXXII, figs. 14–18.) Some specimens are considerably smaller than in the typical form, viz.: length 16–21 μ; breadth 12–15 μ; breadth of isthmus 3–4 μ. (Tab. 24, figs. 14, 15.) Samples 7, 19, 42.

Geographical Distribution.—England; Wales; Scotland; Ireland; France; Germany; Switzerland; Bohemia and Galicia in Austria; Denmark; Finland; Faeroes; Greenland; Bosnia; Siberia; Japan; India; New Zealand; Australia; West and East Africa; Azores; United States; Brazil; Argentina; Patagonia; South Africa.

161. *C. laeve* Rabenh. (W. & G. S. West, Monogr. Brit. Desm., Vol. III, 1908, p. 99, Pl. LXXIII, figs. 8–19.) Samples 37, 38.

Geographical Distribution.—England; Wales; Scotland; Ireland; France; Germany; Galicia in Austria; Hungary; Italy; Spain; Portugal; Norway; Poland; North Russia; Faeroes; Nova Zembla; India; Ceylon; Burma; Siam; Australia; Madagascar; Central and East Africa; Azores; United States; West Indies; Ecuador; Uruguay; Argentina; Patagonia; Switzerland; South Africa.

162. *C. laeve* var. *majus* var. nova. Differt a typo speciei cellulis multo maioribus. Formae intermediae haud visae.

This differs from the typical form in having much larger dimensions. Cells 1·5–1·7 times longer than broad. Length 48–50 μ; breadth 29–32 μ; breadth of isthmus 10–11 μ. (Tab. 24, fig. 7.) Samples 37, 39.

163. *C. maximum* (Börg.) W. & G. S. West var. *minor* West. (W. & G. S. West, Welwitsch's African Freshwater Algae, Journ. of Bot., Vol. XXXV, 1897, p. 114, Tab. 367, fig. 21.) Cells slightly larger than in the typical form. Length 69·5–70 μ; breadth 55·5–58 μ (with spines 60·5–66 μ); breadth of isthmus 12–14·5 μ. (Tab. 27, fig. 5.) Sample 24.

Geographical Distribution.—Central Africa; First record for South Africa.

164. *C. meneghinii* Bréb. (W. & G. S. West, Monogr. Brit. Desm., Vol. III, 1908, p. 90, Pl. LXXII, figs. 29–32.) Sample 38.

Geographical Distribution.—England; Wales; Scotland; Ireland; France; Germany; Austria (and Galicia); Hungary; Italy; Norway; Sweden; Denmark; Bornholm; Finland; Poland; Lapland; North, Central and South Russia; Faeroes; Iceland; Nova Zembla; Greenland; Siberia; Mongolia; China; Japan; India; Ceylon; Siam; Chatham Island; New Zealand; Madagascar; Central Africa; Azores; United States; Porto Rico; Jamaica; Brazil; Ecuador; Paraguay; Argentina; Patagonia; Switzerland; South Africa.

165. *C. nanum* spec. nova, affinis *C. pseudarcto* Nordst., sed cellulis ad apicem leviter deplanatis et sinu profunde constricto distincta.

Near *C. pseudarctoum* Nordst. (W. & G. S. West, Monogr. Brit. Desm., Vol. III, 1908, p. 32, Pl. LXVIII, figs. 12–14; Pl. LXXII, figs. 40, 41); but the cells are slightly depressed at the apices and are deeply constricted at the sinus. Cells very small, 1·7–1·8 times as long as broad; sinus narrowly linear; semicells semicircular with a slightly

truncately-rounded apex. Cell wall smooth. Each chloroplast contains one central pyrenoid. Length 14–20 μ; breadth 8–12 μ; breadth of isthmus 3–4·5 μ. (Tab. 24, fig. 12.) Sample 19.

166. *C. norimbergense* Reinsch. (W. & G. S. West, Monogr. Brit. Desm., Vol. III, 1908, p. 52, Pl. LXIX, figs. 25–27.) Sample 38.

Geographical Distribution.—England; Wales; Scotland; Ireland; Germany; Hungary; Sweden; Bornholm; Finland; India; Ceylon; Siam; New Zealand; Central Africa; Japan; First record for South Africa.

167. *C. nylstromicum* spec. nova., affinis *C. nägeliano* Bréb., sed cellulis multo maioribus, numero undulationum membranae et forma angulorum basalium semicellularum differt.

This somewhat resembles *C. nägelianum* Bréb. (W. & G. S. West, Monogr. Brit. Desm., Vol. III, 1908, p. 14, Pl. LXVI, fig. 12); but differs in the number of undulations, the delineation of the basal angles of the semicells, and in having larger dimensions. Cells of medium size, about 1·2–1·3 times longer than broad, deeply constricted, sinus narrowly linear with a slightly dilated extremity; semicells truncate-pyramidate, basal angles rounded, sides with 4–5 undulations, apical margin with four undulations; cell wall smooth and colourless. In each semicell there is one axile chloroplast containing a single central pyrenoid. Length 41–49 μ; breadth 33–36 μ; breadth of isthmus 18–19·5 μ; breadth of apex 18–20 μ. (Tab. 26, fig. 13.) Sample 19.

168. *C. obliquum* Nordst. forma *minima* West. (W. & G. S. West, Monogr. Brit. Desm., Vol. III, 1908, p. 51, Pl. LXIX, figs. 22, 23.) Sample 27.

Geographical Distribution.—England; Norway; First record for South Africa.

169. *C. obsoletum* (Hantzsch) Reinsch var. *transvaalense* var. nova. Hae cellulae praeter membranae crassationem ad semicellularem basium angulos, etiam alteram membranae crassationem ad apicem ostendunt, polis plus quam in typo applanatis.

This differs from the typical form (W. & G. S. West, Monogr. Brit. Desm., Vol. II, 1905, p. 133, Pl. LVI, figs. 1–3) in the cell wall being thickened at the apices; semicells more depressed. Length 40–46 μ; breadth 46–50 μ; breadth of isthmus 12–13 μ. (Tab. 28, figs. 1–3.) Samples 24, 25, 27, 38, 39, 41.

170. *C. orthostichum* Lund. var. *compactum* W. & G. S. West. (W. & G. S. West, Monogr. Brit. Desm., Vol. III, 1908, p. 169, Pl. LXXX, fig. 22.) Samples 7, 43.

Geographical Distribution.—Scotland; First record for South Africa.

171. *C. orthostichum* var. *pseudopumilum* var. nova, affinis var. *pumilo* Lund., sed semicellulis minus applanatis et sculptura membranae toto caelo differt.

This differs from var. *pumilum* Lund. (W. & G. S. West, Monogr. Brit. Desm., Vol. III, 1908, p. 169, Pl. LXXX, figs. 20, 21) in having less flattened semicells and in the sculpture of the cell wall. Cells small, a little longer than broad, deeply constricted, sinus open outwards; semicells subelliptic, with a somewhat flattened apex. Cell wall granulate, granules without any definite arrangement; chloroplasts with one pyrenoid each. Length 23–29 μ; breadth 19·5–24 μ; breadth of isthmus 8·5–12 μ. (Tab. 25, fig. 3.) Sample 3.

172. *C. orthostichum* var. *transvaalense* var. nova, a typo speciei numero et dispositione granulorum in membrana et sinu angustiore differt.

This differs from the typical form (W. & G. S. West, Monogr. Brit. Desm., Vol. III, 1908, p. 167, Pl. LXXX, figs. 12–19) in the number and disposition of the granules, and in having a narrower sinus. Cell wall granulate, granules arranged in 9–10 vertical

series, with 4–6 granules in each series; granules more or less of the same size. Length 19–22 μ; breadth 16–18 μ; breadth of isthmus 5·5–6 μ. (Tab. 26, fig. 8.) Samples 20, 22.

173. *C. pachydermum* Lund. var. *waterbergense* var. nova, affinis *C. pachydermo* var. *aethiopico* W. et. G. S. West, sed cellulis aliquanto minoribus et ad apicem deplanatis differt.

This is near *C. pachydermum* var. *aethiopicum* W. & G. S. West (W. & G. S. West, Monogr. Brit. Desm., Vol. II, 1905, p. 140, Pl. LVII, figs. 8, 9); but differs in having smaller dimensions and flattened apices and in the cell wall sculpture. Cell wall more or less regularly granulate, granules small. Length 43–54 μ; breadth 36–46 μ; breadth of isthmus 21–25 μ. (Tab. 28, fig. 4.) Samples 18, 51, 52, 53, 54, 57, 58, 72.

174. *C. pseudamoenum* Wille. (W. & G. S. West, Monogr. Brit. Desm., Vol. IV, 1912, p. 31, Pl. CII, figs. 7–9.) (Tab. 29, figs. 9, 10.) Samples 66, 70, 71.

Geographical Distribution.—England; Ireland; Germany; Galicia in Austria; Sweden; Bornholm; Finland; North Russia; Central China; New Zealand; East Africa; United States; Brazil; First record for South Africa.

175. *C. pseudoprotractum* spec. nova, affinis *C. protracto* (Näg.) De Bary, sed lobo polari amplius rotundato, forma cellulae a latere visae et dispositione granulorum differt.

Near *C. protractum* (Näg.) De Bary (W. & G. S. West, Monogr. Brit. Desm., Vol. III, 1908, p. 181, Pl. LXXXII, fig. 8; Pl. XCLV, figs. 4, 5); but the shape of the apical lobe, the shape of the semicells in lateral view and the arrangement of the granules differ. Cells of medium size, longer than broad, deeply constricted, sinus narrowly linear with a slightly dilated extremity; semicells 3-lobed, with a subrectangular incision between the apical lobe and each lateral lobe, lateral and apical lobes broadly rounded and fairly short; lobes granulate, granules large and arranged in 3–4 more or less distinct horizontal rows and in somewhat irregular vertical rows. Side view of semicell subovate; vertical view rather narrowly elliptic, with a smooth protuberance at the middle on each side. Chloroplasts axile, with one pyrenoid each. Length 48 μ; breadth 32–34 μ; breadth of isthmus 12·5–14 μ; thickness 20–21 μ; breadth of apical lobe 16–19 μ. (Tab. 25, figs. 4–6.) Samples 9, 11.

176. *C. pseudopyramidatum* Lund. (W. & G. S. West, Monogr. Brit. Desm., Vol. II, 1905, p. 201, Pl. LXIV, figs. 9–12.) Samples 19, 25.

Geographical Distribution.—England; Wales; Scotland; Ireland; France; Germany; Austria and Galicia; Poland; Hungary; Italy; Norway; Sweden; Finland; North and South Russia; Siberia; Spitzbergen; Nova Zembla; Faeroes; Ceylon; Siam; New Zealand (var.); Australia; West, Central and East Africa; Madagascar; United States; West Indies; Brazil; Paraguay; Uruguay; Switzerland; Mozambique; South Africa.

177. *C. pseudotaxichondrum* Nordst. var. *atomicum* var. nova, affinis *C. pseudotaxichondro* var. *siamensi* W. et G. S. West, sed membrana haud undulata, cellula a vertice visa ad polum utrimque denticulo ornata distincta est.

This variety is near var. *siamense* W. & G. S. West (W. & G. S. West, Siamese Desmids, Botanisk Tidsskrift, Bind 24, 1902, p. 173, Tavle 3, fig. 26); but there are no undulations; each pole has a small tooth in vertical view. Length 31–32 μ; breadth 28–28·5 μ; breadth of isthmus 11–12 μ; thickness 16–18 μ. (Tab. 25, figs. 1, 2.) Sample 3.

178. *C. pyramidatum* Bréb. (W. & G. S. West, Monogr. Brit. Desm., Vol. II, 1905, p. 199, Pl. LXIV, figs. 5–7.) Samples 24, 25, 27, 39.

Geographical Distribution.—England; Wales; Scotland; Ireland; France; Germany; Austria and Galicia; Hungary; Italy; Norway; Sweden; Denmark; Bornholm; Finland; South Russia; India; Ceylon; Burma (form); West Africa; Azores; United States; Brazil; Paraguay; Uruguay (form); Argentina; Patagonia (form); Switzerland; Japan; Mozambique; South Africa.

179. *C. pyramidatum* var. *elongatum* var. nova. Differt a typo speciei cellulis dimidio longioribus, nulla latitudinis discrepantia.

The cells are about one and a half times longer than the typical form; but the difference in breadth is slight. Cells very large, slightly more than twice as long as broad; sides of semicells almost straight, apex slightly concave, cell wall with a thickening at the apices and densely punctate. Length 149–150 μ; breadth 69·5–70 μ; breadth of isthmus 26–28 μ. (Tab. 27, fig. 10.) Sample 22.

180. *C. pyramidatum* var. *majus* var. nova, a typo speciei et cellulis aliquantulo maioribus et quod membranae cellularum in apicibus crassiores fiunt, et semicellularis non ita constanter truncatis et pyramidalibus differt.

The shape of the cells in front view is somewhat variable, the cells are larger than in the typical form, and the cell wall is densely punctate and thickened at the apices. This may also be compared with *C. pseudopyramidatum* Lund. subsp. *maximum* Börgesen forma *minor* Fritsch & Rich (F. E. Fritsch & F. Rich, Trans. Roy. Soc. of S. Afr., Vol. XI—Part 4, 1924, p. 347, fig. 17–E–G) to which it has a great resemblance as far as the shape of its semicells in front view is concerned, but from which it differs in having larger dimensions, in having no thickening of the membrane in the region above the isthmus, as seen in lateral and vertical views in the majority of the specimens investigated, and in the individuals always containing two pyrenoids per semicell. Length 118–130 μ; breadth 70–76 μ; breadth of isthmus 26–30 μ. (Tab. 24, figs. 4, 5.) Samples 38, 39, 41.

181. *C. quadratum* Ralfs var. *africanum* Fritsch. (F. E. Fritsch & E. Stephens, Trans. Roy. Soc. of S. Afr., Vol. IX, 1921, p. 33, fig. 12.)

Cells about 1·6–1·8 times as long as broad; basal angles of semicells less prominent than in the type; cell wall distinctly punctate. Length 41–64 μ; breadth 24–36 μ; breadth of isthmus 8–10 μ. (Tab. 24, fig. 10.) Sample 24.

Geographical Distribution.—South Africa.

182. *C. reniforme* (Ralfs) Arch. (W. & G. S. West, Monogr. Brit. Desm., Vol. III, 1908, p. 157, Pl. LXXIX, figs. 1, 2; Pl. LXXXII, fig. 15.) Specimens usually slightly smaller than in the typical form. Length 40–46 μ; breadth 38–48 μ; breadth of isthmus 13–17 μ. (Tab. 28, figs. 5, 6.) Samples 4, 7, 19, 30, 32, 42, 47, 48, 51, 57.

Geographical Distribution.—England; Wales; Scotland; Ireland; France; Germany; Switzerland; Austria and Galicia; Italy; Norway; Sweden; Faeroes; Greenland; Spitzbergen; United States; Brazil; Argentina; South Africa.

183. *C. schweickerdtii* spec. nova, affinis *C. cucumi* (Corda) Ralfs. Margo apicalis membranae crenis—binis vel ternis—ornatus est; iuxta marginem apicalem bina vel terna granula adsunt conspicua ac sub granulis 3 vel 4 depressiones ellipticae.

Near *C. cucumis* (Corda) Ralfs (W. & G. S. West, Monogr. Brit. Desm., Vol. II, 1905, p. 152, Pl. LIX, figs. 18–20); but the apical margin has 2–3 crenations, there are 2–3 large granules within the median part of the apex and 3–4 elliptical depressions just below the granules. Cells small, about 1·4 times longer than broad, deeply con-

stricted, sinus narrowly linear; semicells more or less semicircular. Cell wall punctate. Length 38–40 μ; breadth 28 μ; breadth of isthmus 10–11 μ. (Tab. 29, figs. 7, 8.) Sample 71.

Named after Prof. Dr. H. G. Schweickerdt, Head of the Department of General Botany, University of Pretoria.

184. *C. sexangulare* Lund. (W. & G. S. West, Monogr. Brit. Desm., Vol. III, 1908, p. 81, Pl. LXXII, fig. 3.) (Tab. 25, fig. 9.) Samples 24, 25.

Geographical Distribution.—Scotland; Germany; Galicia in Austria; Hungary; Sweden; Poland; North and South Russia; Japan; Australia; East Africa; Azores; United States; South Africa.

185. *C. sexnotatum* Gutw. var. *simplex* var. nova, affinis *C. sexnotato* var. *tristriato* (Lütkem.) Schmidle, sed membrana cellulae omnino glabra differt.

Near var. *tristriatum* (Lütkem.) Schmidle (W. & G. S. West, Monogr. Brit. Desm., Vol. III, 1908, p. 228, Pl. LXXXVI, figs. 8, 9); but the cell wall is smooth and without granules. Sides of semicells convex and 5-crenate, apex truncate and straight. Length 28 μ; breadth 22 μ; breadth of isthmus 10 μ; breadth of apex 11–12 μ. (Tab. 24, figs. 8, 9.) Sample 19.

186. *C. speciosum* Lund. var. *simplex* Nordst. forma *africanum* forma nova, a varietate *simplici* Nordst. forma genuinum numero granulorum et cellula apicem versus minus deplanata differt.

These specimens form a group within the limits of Nordstedt's variety (W. & G. S. West, Monogr. Brit. Desm., Vol. III, 1908, p. 250, Pl. LXXXIX, fig. 6); but which nevertheless can be distinguished by the number of granules and less attenuated apices. Margins of semicells crenate, crenations 14–16 (four apical and 5–6 lateral); granulate within the margins, granules in regular radial series, seven granules in each series, basal vertical series of granules absent. Chloroplasts axile, with one pyrenoid each. Length 44–48 μ; breadth 26–28 μ; breadth of isthmus 16–18 μ. (Tab. 26, figs. 9, 10.) Sample 19.

187. *C. subauriculatum* W. & G. S. West. (W. & G. S. West, The Freshwater Algae of Madagascar, Trans. Linn. Soc. London, Ser. 2, Vol. V, 1895–1901, Pl. 6, fig. 31.) Sample 71.

Geographical Distribution.—Madagascar; South Africa.

188. *C. subconnatum* spec. nova, a latere visa affinis *C. connato* Bréb. var. *truncato* West, sed a fronte visa cellulis plus deplanatis et pyramidalibus distincta.

In lateral view, this species resembles the front view of *C. connatum* Bréb. var. *truncatum* West (W. & G. S. West, Monogr. Brit. Desm., Vol. II, 1908, p. 26, Pl. LXVII, fig. 18); but it has rounded apices; the semicells in front view are somewhat truncate-pyramidate. Cells of medium size, about 1·1–1·3 times longer than broad, moderately constricted, sinus very widely open with an obtuse apex; semicells transversely subelliptic with a broad base, apex flattened. Cell wall punctate with two series of minute punctae on each side of the isthmus. Side view of semicell subovate. Chloroplasts containing two pyrenoids each. Length 42–66 μ; breadth 34–56 μ; breadth of isthmus 24–38 μ. (Tab. 26, figs. 14, 15.) Sample 20.

189. *C. subcostatum* Nordst. var. *warmbadianum* var. nova, differt a typo speciei dispositione et numero granulorum in membrana.

This differs from the typical form (W. & G. S. West, Monogr. Brit. Desm., Vol. III, 1908, p. 236, Pl. LXXXVII, figs. 3–5) in the number and arrangement of the granules. Sides of semicells convex and crenulate, with about two small entire crenulations near the basal angles and 3–5 emarginate (or bigranulate) crenulations on the rest of the

lateral margin; apex truncate and with a few small undulations; within the margin minutely granulate, granules radially and concentrically disposed; opposite each of the three crenulations at the base of the semicell is a series of three granules, the two series next to the margin opposite the next crenulation binate and the series nearest the centre single, the first series next to the margin opposite the following two crenulations binate and the second and third series single; next to the apex two series of two granules each; in the centre, above the isthmus with a granulated tumour, granules in three vertical series of three each. Length 32–36 μ; breadth 27–30 μ; breadth of isthmus 10–12 μ; breadth of apex 12–13 μ. (Tab. 25, figs. 12–14.) Sample 48.

190. *C. subtumidum* Nordst. var. *klebsii* (Gutw.) W. & G. S. West. (W. & G. S. West, Monogr. Brit. Desm., Vol. II, 1905, p. 193, Pl. LXIII, figs. 21–23.) Sample 7.

Geographical Distribution.—England; Wales; Scotland; Ireland; Germany; Galicia in Austria; South Africa.

191. *C. subtumidum* var. *theronii* var. nova, affinis *C. subtumido* var. *klebsii* (Gutw.) W. et G. S. West, sed cellulis triplo maioribus, membrana cellulae densis punctis distincta, sinu foras aperto differt.

Near var. *klebsii* (Gutw.) W. & G. S. West; but differs in the cells being about thrice the size of var. *klebsii*, and in having an open sinus and a densely punctated cell wall. Cells very large, about 1·2–1·4 times as long as broad, deeply constricted, sinus open; semicells broadly pyramidate with truncate apices, basal angles rounded. Cell wall very densely punctate, with a thickening at the apex of each semicell. Each chloroplast with two pyrenoids. Length 141·5–148 μ; breadth 104–124 μ; breadth of isthmus 42–44 μ; breadth of apices 40–43·5 μ. (Tab. 27, fig. 9.) Samples 42, 72.

Named after Mr. J. E. Theron of Rietfontein 288, near Nylstroom.

192. *C. tetragonum* (Näg.) Arch. var. *transvaalense* var. nova, affinis *C. tetragono* var. *eleganti* (Roy et Biss.) W. et G. S. West, sed numero undulationum membranae. sculptura eiusdem, et cellula apicem versus minus vel omnino non deplanata differt.

Near var. *elegans* (Roy et Biss.) W. & G. S. West (W. & G. S. West, Monogr. Brit. Desm., Vol. III, 1908, p. 20, Pl. LXVI, fig 27); but differs in the number of undulations, in the cell wall sculpture and in the semicells, which are less attenuated towards the apices. Cells about 1·6–1·7 times as long as broad; sides of semicells (including the angles) 7–8-undulate, apex with 8–10 undulations; with a series of three granules within each lateral undulation and a series of five granules within each apical undulation. In each semicell there is one axile chloroplast containing two pyrenoids. Length 44–51 μ; breadth 29–34 μ; breadth of isthmus 17–20·5 μ; breadth of apices 21–32 μ. (Tab. 26, figs. 11, 12.) Sample 19.

193. *C. trachypleurum* Lund. var. *pseudonatalensis* var. nova, affinis *C. trachypleuro* var. *natalensi* Fritsch et Rich, sed hic spinarum vel maxima pars in margine sita, quum in Fritschii et Richii varietate aliquantulum introrsum ab margine absit.

This differs from var. *natalensis* Fritsch & Rich (F. E. Fritsch & F. Rich, Trans. Roy. Soc. of S. Afr., Vol. XI—Part 4, 1924, p. 349, fig. 18–I–J) in having pronounced spines on the margins and about three series of spines within the margins. Length 60–64 μ (with spines 67–69 μ); breadth 48–51·5 μ (with spines 56–57 μ); breadth of isthmus 18–19 μ. (Tab. 27, fig. 7.) Sample 24.

194. *C. trachypleurum* var. *pseudonatalensis* forma *irregulare* forma nova. Dentes temere dispositi. Semicellula dentibus ternis sub margine apicali glabro munita est.

In these specimens the spines are irregularly disposed, and there are three spines just within the apical margin, which is smooth. Length 58–59 μ; breadth 44–47 μ; breadth of isthmus 16–17 μ. (Tab. 27, fig. 6.) Sample 25.

195. *C. trachypleurum* var. *subspinosum* var. nova, affinis *C. trachypleuro* var. *spinoso* West, sed differt quod singularum semicellularum media in parte iuxta supra isthmum quattuor tantum spinulae adsunt.

The specimens closely resemble var. *spinosum* West (G. Nygaard, Trans. Roy. Soc. of S. Afr., Vol. XX—Part 2, 1932, p. 142, fig. 43; W. & G. S. West, Freshwater Algae of Madagascar, Trans. Linn. Soc. London, Ser. 2—Bot., Vol. V, 1895–1901, Pl. 7, fig. 17) except that the median tumour contains only four granules. The shape of the semicells in front view has a greater resemblance to the figure by Nygaard than to the type illustrated by Messrs. West. Length 42–42·5 μ; breadth 32·5–34 μ; breadth of isthmus 12–13 μ; breadth of apices 16–18 μ. (Tab. 25, fig. 10.) Sample 47.

196. *C. transvaalense* spec. nova, affinis *C. trachypleuro* Lund., sed semicellulis minus applanatis, margine apicali spinis munito, ore sinus spinoso, et omni spinarum dispositione valde distincta.

This species is near *C. trachypleurum* Lund. (W. & G. S. West, Monogr. Brit. Desm., Vol. III, 1908, p. 172, Pl. LXXXI, figs. 2, 3); but the semicells are less flattened, there are spines on the apical margin, there is a spine at each basal angle, and the cell wall sculpture is different. Cells of medium size, about 1·1–1·3 times longer than broad, deeply constricted, sinus narrowly linear; semicells semicircular, apex somewhat flattened. Cell wall punctate and furnished with a number of irregularly disposed spines. Length 48–50·5 μ; breadth 36–37·5 μ; breadth of isthmus 15–16 μ. (Tab. 25, fig. 11.) Sample 25.

197. *C. trilobulatum* Reinsch. (W. & G. S. West, Monogr. Brit. Desm., Vol. II, 1905, p. 185, Pl. LXII, figs. 28–30.) Samples 19, 72.

Geographical Distribution.—England; Scotland; Ireland; France; Germany; Hungary; North Russia; Poland; Norway; Sweden; New Zealand; Madagascar; Central and East Africa; Brazil; Japan; South Africa.

198. *C. tumidum* Lund. (W. & G. S. West, Monogr. Brit. Desm., Vol. II, 1905, p. 160, Pl. LX, fig. 18.) Sample 71.

Geographical Distribution.—Wales; Scotland; Ireland; France; Germany (form); Norway; Sweden; Denmark; Poland; North Russia; Finland; Greenland; United States; First record for South Africa.

199. *C. waterbergense* spec. nova, affinis *C. holmiensi* Lund., sed membrana haud undulata differt.

Near *C. holmiense* Lund. (W. & G. S. West, Monogr. Brit. Desm., Vol. III, 1908, p. 1, Pl. LXV, figs. 1, 2); but differs in having crenulations. Cells rather small, about 1·5–1·8 times longer than broad, deeply constricted, sinus narrowly linear; semicells broadly pyramidate with a flattened apex, basal angles rounded. Cell wall punctate. Length 35–39 μ; breadth 20–26·5 μ; breadth of isthmus 8–9·5 μ; breadth of apex 12–14 μ. (Tab. 26, figs. 1–7.) Sample 19.

Xanthidium *Ehrenberg.*

200. *X. cristatum* Bréb. var. *delpontei* Roy & Biss. forma *laevis* forma nova, differt a varietate *delpontei* et membrana cellulae omnino glabra et quod spinulae supra isthmum desunt.

A form in which the semicells are entirely destitute of a thickened or scrobiculated central area; the shape of the semicells differ slightly from the typical form (W. & G. S. West, Monogr. Brit. Desm., Vol. IV, 1912, p. 74, Pl. CXI, fig. 5). Length 72 μ (with spines 90–94 μ); breadth 68 μ (with spines 80–88 μ); breadth of isthmus 15·5 μ. (Tab. 29, fig. 12.) Sample 74.

201. *X. cristatum* var. *transvaalense* var. nova, affinis var. *delpontei* Roy et Biss., sed cellulis multo angustioribus differt. Formae intermediae non visae.

This differs from var. *delpontei* in the narrower semicells. Cells about 1·25–1·5 times longer than broad; each tumour above the isthmus with a circle of 7–10 small spines; in some specimens there may be a spine in the centre of the circle. Length 48–56 μ; breadth 38–44 μ; breadth of isthmus 16–18 μ; length of spines 8–12 μ. (Tab. 28, figs. 7–10.) Samples 24, 25.

Straurastrum *Meyen.*

202. *St. barbaricum* spec. nova, affinis *St. caffrorum* Claassen sed differt quod depressio in margine apicali deest, porro supra isthmum tantum una series spinularum adest sculpturaque membranae etiam differt.

This is near *St. caffrorum* Claassen; but differs in having no cavity in the apical margin, and in the cell wall sculpture. Cells small, about 1·3–1·4 times as long as broad, deeply constricted, sinus open; semicells more or less quadrangular in vertical view, with a single series of spines near the base, apical margin and angles furnished with spines. Length 28 μ; breadth 20–21·5 μ; breadth of isthmus 7 μ. (Tab. 30, figs. 10, 11.) Sample 3.

203. *St. brevispinum* Bréb. var. *masoganum* var. nova, affinis *St. brevispino* var. *obverso* W. et G. S. West, sed sinu latiore et cellularum e vertice visarum lateribus undulatis neque concavis differt.

This variety is near var. *obversum* W. & G. S. West (W. & G. S. West, Monogr. Brit. Desm., Vol. IV, 1912, p. 148, Pl. CXXIII, fig. 7); but the sinus is broader, and the sides in vertical view are undulate and not concave. Cells small, slightly shorter than broad, deeply constricted, sinus open; semicells more or less fusiform, each apical angle furnished with a short spine. Vertical view of cell triangular, sides 3-undulate. Cell wall smooth. One pyrenoid per chloroplast. Length 26 μ; breadth 28 μ; breadth of isthmus 8 μ. (Tab. 29, figs. 19, 20.) Sample 66.

204. *St. caffrorum* spec. nova. Inter species descriptas nulla affinitas obvia. Semicellulae e vertice visae plus minusve quadratae, margo apicalis depressione praeditus, quae spinis brevibus circumdata est. Supra isthmum duae series spinularum adsunt et anguli apicales semicellularum etiam spinulis muniti.

Cells small, about 1·2 times as long as broad, deeply constricted, sinus open outwards; semicells subelliptic, more or less quadrangular in vertical view, apical margin with a cavity in the median part, margin of cavity furnished with short spines; above the isthmus in each semicell are two series of small spines, apical angles furnished with spines. Length 24 μ; breadth 20 μ (greatest—fig. 7) and 16 μ (smallest—fig. 9); breadth of isthmus 8 μ. (Tab. 30, figs. 7–9.) Sample 3.

205. *St. connatum* Roy & Biss. var. *warmbadianum* var. nova, affinis *St. connato* var. *americano* W. et G. S. West, sed differt et semicellulis latioribus brevioribusque et quod a vertice visa latera concaviora sunt.

This closely resembles var. *americanum* W. & G. S. West (W. & G. S. West, North American Desmidieae, Trans. Linn. Soc. London, Ser. 2, Bot., Vol. V, 1895–1901, Pl. 16, fig. 7); but the semicells are shorter and broader, and the sides in vertical view are more concave. Length 20–22 μ; breadth 22–23 μ; breadth of isthmus 6–7·5 μ. (Tab. 31, figs. 23, 24.) Sample 47.

206. *St. crenatum* spec. nova, affinis *St. elliptico* West, sed membrana cellulae crenata differt.

Near *St. ellipticum* West (W. & G. S. West, Monogr. Brit. Desm., Vol. IV, 1912, p. 138, Pl. CXIX, fig. 7); but the cell wall is crenated. Cells small, about 1·2 times as long as broad, deeply constricted, sinus widely open; semicells triangular in vertical view. Length 24–25 μ; breadth 20–20·5 μ; breadth of isthmus 9–10 μ. (Tab. 31, figs. 21, 22.) Samples 54, 58, 63.

207. *St. dickiei* Ralfs. (E. Messikommer, Beiträge zur geobotanischen Landesaufnahme der Schweiz, Heft 24, 1942, Taf. XII, figs. 3, 4.) Spine on apical angle straight or slightly incurved. (Tab. 31, figs. 7, 8.) Samples 59, 72.

Geographical Distribution.—Davos in Switzerland; Madagascar; United States; First record for South Africa.

208. *St. dilatatum* Ehrenb. (W. & G. S. West, Monogr. Brit. Desm., Vol. IV, 1912, p. 172, Pl. CXXVI, figs. 10–15.) Sinus less widely open than in the type and all the specimens observed were triangular in vertical view. The Rietfontein and Mosdene specimens are slightly larger than the other specimens. Length 24–40 μ; breadth 20–36 μ; breadth of isthmus 5–12 μ. (Tab. 30, figs. 1–6; Tab. 31, figs. 14–16.) Samples 2, 3, 12, 19, 20, 24, 27, 32, 35, 38, 41, 42, 51, 65, 66, 67, 71, 72.

Geographical Distribution.—England; Wales; Scotland; Ireland; France; Germany; Austria and Galicia; Hungary; Roumania; Servia; Macedonia; Italy; Portugal; Norway; Sweden; Denmark; Central and South Russia; Greenland; Japan; India; Ceylon; Australia; New Zealand; Madagascar; Central Africa; Azores; United States; Brazil; Bolivia; Paraguay; Argentina; South Africa.

209. *St. excavatum* W. & G. S. West. (W. & G. S. West, The Freshwater Algae of Madagascar, Trans. Linn. Soc. London, Ser. 2, Bot., Vol. V, 1895–1901, Pl. 8, fig. 42.) Length 12 μ; breadth 10 μ; length of arms 12–20 μ; breadth of isthmus 6 μ. (Tab. 32, fig. 7.) Samples 65, 72.

Geographical Distribution.—Madagascar; First record for South Africa.

210. *St. furcatum* (Ehrenb.) Bréb. (F. Rich, Trans. Roy. Soc. of S. Afr., Vol. XX—Part 2, 1932, p. 175, fig. 11 A–C.) (Tab. 32, figs. 3–6.) Samples 65, 66, 74.

Geographical Distribution.—Davos in Switzerland; South Africa.

211. *St. galpinii* spec. nova, affinis *St. rotulae* Nordst., sed differt quod semicellula 7 tantum brachiis et margo apicalis 7 papillis est praeditus.

Near *St. rotula* Nordst. (W. & G. S. West, North American Desmidieae, Trans. Linn. Soc. London, Ser. 2, Bot., Vol. V, 1895–1901, Pl. 18, fig. 11); but each semicell has only seven arms, and the apical margin is furnished with seven papillae. Cells of medium size, about 1·75–2·2 times longer than broad, sinus widely open; semicells with seven slightly incurved arms, each arm containing four small spines at the apex, sides crenate with a circle of spines around each crenation (not clear in some specimens); apical margin furnished with seven emarginate projections. Chloroplasts with one

central pyrenoid each. Length 38–44 μ (with papillae 46–50 μ); breadth 18–25 μ (with arms 56–64 μ); breadth of isthmus 10–13 μ. (Tab. 29, figs. 15–17 μ.) Samples 66, 71.

Named after Mr. E. A. Galpin of Mosdene, Naboomspruit.

212. *St. gemelliparum* Nordst. var. *africanum* var. nova, a typo speciei differt quod circulus intimus 6 brachiorum propius mediam cellulae partem dispositus est.

This closely approaches the typical form (W. & G. S. West, The Freshwater Algae of Ceylon, Trans. Linn. Soc. London, Ser. 2, Vol. VI, 1901–1902, Pl. 21, fig. 25); but in vertical view, the inner circle of six arms is nearer to the axis of the cell. Cells small, about 1·4 times as long as broad, deeply constricted, sinus open; semicells more or less elliptical, furnished with six short arms near the base and another six near the apical margin, apices of arms emarginate. Vertical view of semicell triangular, with two arms on each angle and a circular series of six arms within the margin, angles truncate. Each chloroplast containing one central pyrenoid. Length 24 μ (with arms 30 μ); breadth 17 μ (with arms 24 μ); breadth of isthmus 9 μ. (Tab. 32, figs. 1, 2.) Sample 66.

213. *St. leptocladum* Nordst. var. *cornutum* Wille. These specimens are larger than in the typical form (W. & G. S. West, Freshwater Algae of Madagascar, Trans. Linn. Soc. London, Ser. 2, Vol. V, 1895–1901, Pl. 9, figs. 12, 13; F. Rich, Trans. Roy. Soc. of S. Afr., Vol. XX—Part 2, 1932, p. 175, fig. 13 F). Length 38–41 μ; breadth 11–14 μ (with processes 72–108 μ); breadth of isthmus 8–9 μ. (Tab. 32, fig. 8.) Sample 74.

Geographical Distribution.—Madagascar; South Africa.

214. *St. mattiei* spec. nova. Nulla affinitate notata. Cellulae parva, aliquanto latiores quam longiores, sinu foras aperto, membrana spinulis praecipue in angulis apicalibus praedita, semicellula e vertice visa lateribus concavis triangulata.

Cells small, slightly shorter than broad, deeply constricted, sinus open. Vertical view of semicell triangular, sides concave. Cell wall furnished with short spines, mainly on the apical angles. Length 17·5–26 μ; breadth 19·5–28 μ; breadth of isthmus 6–14 μ; length of spines 3–4 μ. (Tab. 31, figs. 25–27.) Sample 24.

215. *St. mesianum* spec. nova. Cum sp. *St. subgemmulato* W. et G. S. West congruit quod semicellulis sena brachia sunt, quae tamen glabra sunt, spinula utrimque ad basim tantum praedita.

Near *St. subgemmulatum* W. & G. S. West (W. & G. S. West, The Freshwater Algae of Madagascar, Trans. Linn. Soc. London, Ser. 2, Bot., Vol. V, 1895–1901, Pl. 8, fig. 34) in that each semicell contains six arms, but the arms are smooth and furnished with a small spine on each side at the base. Cells moderately constricted, sinus open; semicells with six gradually attenuated arms, with four small spines at the apex of each arm. Cell wall smooth. Each chloroplast with one pyrenoid. Length 28–29 μ; breadth 20–21 μ (with arms 43–44 μ); breadth of isthmus 10–12 μ. (Tab. 31, figs. 3, 4.) Sample 59.

Named after the late Prof. Dr. M. G. Mes, formerly Head of the Department of Plant Physiology and Biochemistry, University of Pretoria.

216. *St. orbiculare* Ralfs var. *ralfsii* W. & G. S. West. (W. & G. S. West, Monogr. Brit. Desm., Vol. IV, 1912, p. 156, Pl. CXXIV, figs. 12–16.) Cells slightly smaller than in the typical form. Length 26 μ; breadth 21 μ; breadth of isthmus 7·5–8 μ. (Tab. 30, figs. 14, 15.) Sample 60.

Geographical Distribution.—England; Wales; Scotland; Ireland; France; Germany; Switzerland; Austria and Galicia; Hungary; Servia; Italy; Portugal; Norway; Sweden; Denmark; Bornholm; Finland; Poland; North, Central and

South Russia; Faeroes; Iceland; Nova Zembla; Spitzbergen; Greenland; East and North India; Australia; United States; Bolivia; Paraguay; Agentina; Patagonia; Brazil; First record for South Africa.

217. *St. orbiculare* var. *waterbergense* var. nova, affinis *St. orbiculari* var. *hibernico* W. et G. S. West, sed lateralibus, a vertice visis, concavis differt.

Near var. *hibernicum* W. & G. S. West (W. & G. S. West, Monogr. Brit. Desm., Vol. IV, 1912, p. 156, Pl. CXXIV, figs. 5–9); but differs in that the sides are concave in vertical view. Length 31–33 μ; breadth 28–30 μ; breadth of isthmus 7·5–9 μ. (Tab. 31, figs. 5, 6.) Samples 52, 54, 58.

218. *St. pseudogemmulatum* spec. nova, affinis *St. subgemmulato* W. et G. S. West, sed differt ét brachiis leviter incurvatis ét quod semicellulis a vertice visis binae sunt granulorum series, quae circuli modo dispositae ternis consistunt granulis. Circulo interiori sex euismodi sunt series, exteriori tamen duodecim.

This differs from *St. subgemmulatum* W. & G. S. West (W. & G. S. West, The Freshwater Algae of Madagascar, Trans. Linn. Soc. London, Ser. 2, Bot., Vol. V, 1895–1901, Pl. 8, fig. 34) in having slightly incurved arms and in the cell wall sculpture. Cells small, about 1·6–1·7 times longer than broad, sinus open; semicells with six arms, apex of each arm emarginate. Cell wall, in vertical view of semicell, with two circular series of granules arranged in groups of three granules each, inner circle consists of six groups and outer circle contains 12 groups; and with three circles of granules around each arm. Each chloroplast contains a central pyrenoid. Length 29–32 μ; breadth 17–19 μ (with arms 33–34 μ); breadth of isthmus 10–11 μ. (Tab. 31, figs. 9, 10.) Sample 19.

219. *St. pseudogemmulatum* var. *warmbadianum* var. nova, affinis *St. pseudogemmulatum* Claassen, sed brachiis quam prioris varietatis longioribus tenuioribusque differt, quae a vertice visa 4 granula singulis in seriebus ad interiorem circulum habent.

Arms longer and narrower than in *St. pseudogemmulatum* Claassen; cell wall with the inner series of granules consisting of four granules per group. Length 28·5–32 μ; breadth 16–17 μ (with arms 34–37 μ); breadth of isthmus 7·5–9 μ. (Tab. 31, figs. 11–13.) Sample 48.

220. *St. pygmaeum* Bréb. var. *botesii* var. nova, affinis var. *apiculato* W. et G. S. West, sed angulis apicalibus spinalis munitis, ceteroquin omnino glabra differt.

This differs from var. *apiculatum* W. & G. S. West (W. & G. S. West, Freshwater Algae of Madagascar, Trans. Linn. Soc. London, Ser. 2, Bot., Vol. V, 1895–1901, Pl. 8, fig. 26) in the cell wall being smooth except for the apical angles, which contains a few spines. Cells small, about as long as broad, deeply constricted, sinus open; semicells with three spines on the apical angles and a circle of spines near the angles. Vertical view triangular. Length 26–28 μ; breadth 25·5–26 μ; breadth of isthmus 8·5–10 μ. (Tab. 31, figs. 28, 29.) Sample 24.

Named after Mr. P. W. Botes of Moddernek, Nylstroom.

221. *St. quadrangulare* Bréb. var. *subarmatum* var. nova, affinis *St. quadrangulari* var. *armato* W. et G. S. West, sed sinu latiore, spinulis longioribus, et cellulis multo maioribus differt; semicellulae e vertice visae triangulatae.

This differs from var. *armatum* W. & G. S. West (W. & G. S. West, North American Desmidieae, Trans. Linn. Soc. London, Ser. 2, Bot., Vol. V, 1895–1901, Pl. 16, fig. 18) in having a broader sinus, longer spines and considerably larger cells; semicells triangular in vertical view. Fig. 18 shows the cell in front view; it was impossible to keep the cell in vertical position in order to illustrate it. Length 32 μ; breadth 41–43 μ (with spines 48–50 μ); breadth of isthmus 14–14·5 μ. (Tab. 29, fig. 18.) Samples 68, 71.

222. *St. setigerum* Cleve var. *pectinatum* W. et G. S. West forma *australe* forma nova. A var. *pectinato* W. et G. S. West isthmo multo latiore differt.

This form differs from var. *pectinatum* (W. & G. S. West, North American Desmidieae, Trans. Linn. Soc. London, Ser. 2, Bot., Vol. V, 1895–1901, Pl. 16, fig. 28) in that the isthmus is about 2·2 times broader. Length 33 μ (with spines 46 μ); breadth 32 μ (with spines 48 μ); breadth of isthmus 14 μ. (Tab. 29, figs. 13, 14.) Sample 65.

223. *St. subgemmulatum* W. & G. S. West var. *mattiei* var. nova, affinis var. *gracili* W. et G. S. West, sed cellulae brachiis longioribus tenuioribusque praeditae eam distinguunt.

These specimens are near var. *gracilius* W. & G. S. West (W. & G. S. West, The Freshwater Algae of Madagascar, Trans. Linn. Soc. London, Ser. 2, Bot., Vol. V, 1895–1901, Pl. 8, fig. 35); but differ in possessing longer and narrower arms. Length 32–32·5 μ; breadth 15–17 μ (with arms 43·5–46 μ); breadth of isthmus 10–11 μ. (Tab. 31, figs. 1, 2.) Sample 59.

224. *St. subtrifurcatum* West forma *major* W. & G. S. West. These specimens are larger than in the typical form (W. Schmidle, Engler Bot. Jahrb., XXXII Bd., 1903, p. 73, Taf. II, fig. 8). Length 72–76 μ; breadth 58–62 μ; breadth of isthmus 24–26·5 μ; length of spines 20–36 μ. (Tab. 30, figs. 16–18.) Samples 24, 25, 39.

Geographical Distribution.—Central Africa; First record for South Africa.

225. *St. teliferum* Ralfs var. *transvaalense* var. nova. A typo speciei spinulis hebetatis differt.

This is near *St. teliferum* Ralfs (E. Messikommer, Beiträge zur geobotanischen Landesaufnahme der Schweiz, Heft 24, 1942, Taf. XIV, fig. 8); but differs in the spines being blunt. Length 30·5–31 μ; breadth 28 μ; breadth of isthmus 11–13 μ; length of spines 2·5–4 μ. (Tab. 31, figs. 19, 20.) Sample 19.

This may also be compared with *St. breviaculeatum* G. M. Smith (Wm. R. Taylor, Alpine Algae from the Santa Marta Mountains, Colombia., Am. Journ. of Bot., Vol. 22, 1935, p. 772, Pl. 2, fig. 5).

226. *St. trihedrale* Wolle var. *australe* var. nova. A typo speciei isthmo multo latiore differt.

This differs from the typical form (W. & G. S. West, North American Desmidieae, Trans. Linn. Soc. London, Ser. 2, Bot., Vol. V, 1895–1901, Pl. 16, fig. 29) in that the isthmus is 1·5 times broader. Length 44 μ; breadth 30 μ; breadth of isthmus 14–15·5 μ. (Tab. 31, figs. 17, 18.) Sample 27.

227. *St. tumidum* Bréb. (W. & G. S. West, Monogr, Brit. Desm., Vol. IV, 1912, p. 142, Pl. CXXII, figs. 1–5.) Sample 71.

Geographical Distribution.—England; Wales; Scotland; Ireland; France; Germany; Galicia in Austria; Norway; Denmark; Sweden; Bornholm; United States; First record for South Africa.

228. *St. xiphidiophorum* Wolle var. *westiorum* var. nova. E vertice visae cellulae cum var. *brachyacantho* W. et G. S. West valde congruunt, sed differt spinis in angulis apicalibus multo brevioribus.

This closely resembles var. *brachyacanthum* W. & G. S. West (W. & G. S. West, North American Desmidieae, Trans. Linn. Soc. London, Ser. 2, Bot., Vol. V, 1895–1901, Pl. 18, fig. 7) in vertical view; but the spines on the apical angles are much shorter and the cells are smaller. Cells small, about 1·3 times as long as broad, fairly deeply constricted, sinus open; basal and apical angles of semicells truncate and furnished

with a few spines. Semicells more or less triangular in vertical view; each angle with three spines (it seems to be 9-angular). Length 24 μ; breadth 18·5–19 μ; breadth of isthmus 10–10·5 μ. (Tab. 30, figs. 12, 13.) Sample 3.

Named after Messrs. W. & G. S. West.

Sphaerozosma *Corda*

229. *Sph. aubertianum* W. West. Cells somewhat smaller than in the type (W. West, Journ. of Bot., Vol. XXVII, 1889, Tab. 291, fig. 17). Length 10–12 μ; breadth 13–16 μ; breadth of isthmus 5–6 μ. (Tab. 32, fig. 9.) Sample 74.

Geographical Distribution.—Maine; First record for South Africa.

Onychonema *G. C. Wallich*

230. *Onychonema* species ad *O. laeve* Nordst. var. *micracanthum* Nordst. The cells correspond with those in Nordstedt's variety except for the somewhat undulated apical margin in some specimens; this may be due to the fixative as other specimens from the fresh material have smooth apical margins. Unfortunately the measurements of Nordstedt's variety are not available. Length 16–18 μ; breadth 20–24 μ (with spines 24–30 μ); breadth of isthmus 4–4·5 μ. (Tab. 32, fig. 10.) Sample 74.

TRIBUS: BACILLARIOPHYTA

The different Diatom taxa have been determined by Dr. B. J. Cholnoky and the descriptions and figures have been published by him. (Beiträge zur Kenntnis der Südafrikanischen Diatomeenflora II. Einige Gewässer im Waterberg-Gebiet, Transvaal. Portugaliae Acta Biologica (Série B) Vol. 6, No. 2, 1958, pp. 99–160, Taf. I–VII. The diatoms of the following samples have not been determined as yet:

30, 36, 37, 38, 39, 41, 42, 43, 44, 66, 67, 68, 69, 70, 71, 72, 73, 74.

Class: Diatomeae.

Order: Centrales.

Suborder: Discineae.

Fam.: Coscinodiscaceae.

Subfam.: Melosiroideae.

Melosira *Agardh.*

231. *M. granulata* (E.) Ralfs. Samples 47, 48, 49, 50, 57.

232. *M. nyassensis* O.M. Sample 12.

233. *M. roeseana* Rabh. Sample 51.

Subfam.: Coscinodiscoideae.

Cyclotella *Kutê.*

234. *C. kützingiana* Thw. Sample 50.

Order: Pennales.

Suborder: Araphidineae.

Fam.: Fragilariaceae.

Subfam.: Fragilarioideae.

Fragilaria *Lyngbye*

235. *F. capucina* Desm. var. *acuta* Grun. Sample 63.
236. *F. fonticola* Hust. Sample 1.
237. *F. ungeriana* Grun. Sample 63.

Asterionella *Hassall*

238. *A. africana* Chy. Sample 49.

Synedra *Ehrenberg*

239. *S. acus* Kg. var. *radians* (Kg.) Hust. Samples 7, 59, 60.
240. *S. rumpens* Kg. Samples 1, 4, 5, 7, 8, 10, 11, 12, 60, 63, 64.
241. *S. rumpens* var. *fragilarioides* Grun. Samples 9, 11, 18.
242. *S. rumpens* var. *meneghiniana* Grun. Samples 5, 7, 8, 10, 11, 12, 23, 47, 63, 64.
243. *S. rumpens* var. *scotica* Grun. Sample 50.
244. *S. ulna* (Nitzsch) E. Samples 1, 4, 5, 6, 8, 9, 11, 15, 18, 19, 20, 23, 32, 46, 47, 48, 49, 50, 51, 52, 53, 55, 57, 58, 60, 63, 64.
245. *S. ulna* var. *biceps* (Kg.) Hust. Samples 1, 5, 6, 7, 8, 12, 13, 47, 48, 50, 60, 63.
246. *S. ulna* var. *danica* (Kg.) Grun. Samples 7, 63, 64.
247. *S. vaucheriae* Kg. Sample 6.

Suborder: Raphidioidineae.

Fam.: Eunotiaceae.

Subfam.: Eunotioideae.

Eunotia *Ehrenberg*

248. *E. alpina* (Näg.) Hust. Sample 24.
249. *E. exigua* (Bréb.) Grun. Samples 2, 3, 24, 25, 26, 27, 28, 29, 33, 35, 45, 46, 51, 52, 53, 54, 55, 56, 57, 58, 63, 64.
250. *E. garusica* Chy. Samples 47, 60.
251. *E. lunaris* (E.) Grun. Sample 60.
252. *E. lunaris* var. *subarcuata* (Näg.) Grun. Sample 51.
253. *E. mogolensis* Chy. Samples 25, 26, 27, 28, 45, 52.
254. *E. montana* Hust. Sample 45.
255. *E. pectinalis* (Kg.) Rabh. Samples 26, 28, 46, 52, 58, 64.
256. *E. pectinalis* var. *minor* (Kg.) Rabh. Samples 46, 52, 54, 55, 56, 57, 58.
257. *E. porcellus* Chy. Sample 25.
258. *E. praerupta* E. var. *inflata* Grun. Sample 54.
259. *E. pseudoflexuosa* Hust. Samples 45, 54, 57.
260. *E. subaequalis* Hust. Samples 23, 25, 26, 27, 28, 29, 35, 45, 46, 47, 48, 51, 52, 53, 54, 55, 56, 57, 58, 59, 63, 64.
261. *E. tenella* (Grun.) Hust. Samples 3, 24, 25, 26, 27, 28, 29, 34, 35, 45, 46, 51, 52, 53, 54, 55, 56, 57, 58, 63.
262. *E. tschirchiana* O.M. Sample 7.
263. *E. zygodon* E. Samples 25, 26, 27, 28, 45.
264. *E. zygodon* var. *elongata* Hust. Samples 26, 27, 28, 29.

Suborder: Monoraphidineae.

Fam.: Achnanthaceae.

Subfam.: Achnanthoideae.

Achnanthes *Bory*

265. *A. exigua* Grun. Samples 6, 63.
266. *A. lanceolata* (Bréb.) Grun. var. *rostrata* Hust. Sample 51.
267. *A. linearis* W. Sm. Samples 13, 14, 15, 32.
268. *A. microcephala* Kg. Samples 1, 4, 5, 6, 7, 8, 9, 10, 11, 12, 15, 20, 22, 23, 29, 32, 33, 45, 47, 49, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 63, 64.
269. *A. minutissima* Kg. Samples 1, 2, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 18, 19, 20, 22, 23, 29, 32, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 63, 64.

Suborder: Biraphidineae.

Fam.: Naviculaceae.

Subfam.: Naviculoideae.

Frustulia *Agardh.*

270. *F. rhomboides* (E.) de Toni. Samples 23, 45, 46, 51, 52, 53, 54, 55, 57, 58.
271. *F. rhomboides* var. *saxonica* (Rabh.) de Toni. Samples 12, 14, 20, 29, 32, 45, 47, 50, 51, 52, 53, 54, 55, 56, 57, 58, 63, 64.
272. *F. vulgaris* (Thw.) de Toni var. *angusta* Chy. Samples 1, 7, 9, 11, 12, 13, 14, 15, 47, 50, 53, 54, 55, 57, 60, 63, 64.

Gyrosigma *Hassall*

273. *G. kützingii* (Grun.) Cl. Samples 1, 7, 10, 12, 13, 15, 18, 20, 23, 47, 48, 49, 50, 62.
274. *G. spenceri* (W. Sm.) Cl. var. *nodifera* Grun. Sample 6.

Caloneis *Cleve*

275. *C. aequatorialis* Hust. var. *tugelae* Chy. Samples 14, 15, 62.
276. *C. bacillum* (Grun.) Cl. Samples 13, 15, 20, 63.
277. *C. chasei* Chy. Sample 22.
278. *C. incognita* Hust. Samples 14, 15, 16, 47.
279. *C. silicula* (E.) Cl. Samples 12, 14, 64.
280. *C. silicula* var. *peisonis* Hust. Samples 47, 50.
281. *C. silicula* var. *truncatula* Grun. Samples 14, 47, 48, 49, 50, 53, 56.

Neidium *Pfitzer*

282. *N. affine* (E.) Cl. Samples 6, 7, 19, 25, 26, 33, 46, 54, 60.
283. *N. affine* var. *amphirhynchus* (E.) Cl. Samples 28, 46, 48, 52, 53, 54, 55, 56, 59.
284. *N. affine* var. *longiceps* (Greg.) Cl. Samples 12, 52, 53, 56, 57.
285. *N. gracile* Hust. Samples 46, 52.
286. *N. gracile* forma *aequale* Hust. Samples 29, 45, 46.
287. *N. iridis* (E.) Cl. Samples 26, 33, 47, 48, 49, 53, 54, 55, 57, 59, 63, 64.
288. *N. iridis* var. *amphigomphus* (E.) van Heurck. Samples 25, 26, 28.
289. *N. iridis* var. *ampliata* (E.) Cl. Sample 56.
290. *N. javanicum* Hust. Sample 58.
291. *N. productum* (W. Sm.) Cl. Samples 14, 15, 26, 46, 54, 56, 58, 63, 64.

Diploneis *Ehrenberg*

292. *D. ovalis* (Hilse) Cl. Sample 59.
293. *D. subovalis* Cl. Sample 52.

Stauroneis *Ehrenberg*

294. *S. anceps* E. Samples 6, 19, 20, 23, 47, 50, 51, 53, 54, 56, 63.
295. *S. anceps* forma *gracilis* (E.) Cl. Samples 46, 52, 53, 54, 55, 56, 58, 64.
296. *S. borrichi* (Petersen) Lund. Samples 53, 56.
297. *S. claasseniae* Chy. Sample 59.
298. *S. crucicula* Grun. Sample 1.
299. *S. phoenicenteron* E. Samples 24, 25, 26, 28, 29, 33, 46, 48, 51, 52, 54, 55, 56, 57, 59, 60.
300. *S. phoenicenteron* forma *gracilis* (Dippel) Hust. Samples 45, 56.

Anomoeoneis *Pfitzer*

301. *A. exilis* (Kg.) Cl. Samples 1, 5, 7, 8, 9, 10, 11, 12, 14, 20, 23, 63.
302. *A. sphaerophora* (Kg.) Pfitzer. Samples 59, 60.

Navicula *Bory*

303. *N. acidophila* Chy. Sample 24.
304. *N. anglica* Ralfs. Samples 12, 13, 14, 16, 20, 22, 47, 48, 49, 50.
305. *N. bryophila* Petersen. Samples 5, 6, 9, 10, 11, 25, 26, 27, 45.
306. *N. cari* E. Samples 13, 17, 46, 59, 61, 62.
307. *N. cari* var. *angusta* Grun. Samples 20, 21, 22, 26, 46, 51, 52, 53, 54, 55, 56, 57, 58, 63, 64.
308. *N. cincta* (E.) Kg. Samples 14, 15, 20, 46, 49, 61, 62.
309. *N. cinctaeformis* Hust. Sample 61.
310. *N. confervacea* Kg. Samples 47, 48.
311. *N. cryptocephala* Kg. Samples 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 24, 25, 26, 28, 29, 32, 33, 34, 35, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64.
312. *N. cryptocephala* var. *intermedia* Grun. Samples 6, 63.
313. *N. cryptocephala* var. *veneta* (Kg.) Grun. Sample 57.
314. *N. cuspidata* Kg. Samples 48, 49, 53, 54, 58, 59, 63.
315. *N. cuspidata* var. *ambigua* (E.) Cl. Samples 15, 20, 21, 22, 46, 49, 51, 55, 56, 57, 59, 60, 63, 64.
316. *N. dicephala* (E.) W. Sm. Samples 15, 48.
317. *N. dicephala* var. *neglecta* (Krasske) Hust. Sample 50.
318. *N. elaborata* Hust. Sample 35.
319. *N. exigua* (Greg.) O.M. Samples 1, 13, 20, 47, 48, 50.
320. *N. exiguiformis* Hust. Samples 51, 63.
321. *N. gastrum* E. Samples 51, 52, 53, 54, 55, 57, 58.
322. *N. graciloides* A. Mayer. Sample 7.
323. *N. gregaria* Donk. Samples 2, 32, 47, 50, 51, 59.
324. *N. gregarioides* Chy. Samples 21, 23, 26, 46, 51, 52, 53, 54, 55, 56, 57, 58, 60, 63.
325. *N. grimmei* Krasske. Samples 1, 4, 13, 35, 47, 48, 59, 63, 64.
326. *N. hungarica* Grun. var. *capitata* (E.) Cl. Samples 1, 20, 48.
327. *N. krasskei* Hust. Samples 25, 29.
328. *N. lanceolata* (Ag.) Kg. Samples 15, 47, 48, 49, 50, 59, 60.
329. *N. longicephala* Hust. Samples 55, 56.
330. *N. mengeae* Chy. Sample 57.

331. *N. menisculus* Schum. Samples 6, 11, 13.
332. *N. microcephala* Grun. Sample 50.
333. *N. minima* Grun. var. *atomoides* (Grun.) Cl. Sample 46.
334. *N. minuscula* Grun. Sample 47.
335. *N. minusculoides* Hust. Samples 60, 61.
336. *N. muralis* Grun. Samples 2, 24, 49.
337. *N. mutica* Kg. Samples 7, 8, 25, 26, 27, 29, 31, 35, 51, 56, 57, 63.
338. *N. mutica* forma *cohnii* (Hilse) Hust. Samples 3, 4, 8, 19, 20, 27, 29, 34.
339. *N. mutica* var. *nivalis* (E.) Hust. Samples 1, 7, 10, 19, 20, 21, 33, 35, 51, 53, 55, 56.
340. *N. mutica* var. *pseudolagerheimii* Chy. Samples 11, 28, 45, 48, 55, 58, 63.
341. *N. nyassensis* O.M. Samples 12, 13, 54, 56, 57, 58, 63.
342. *N. nyassensis* var. *capitata* O.M. Sample 63.
343. *N. nyassensis* var. *minor* Chy. Samples 13, 14, 15, 16, 20, 23, 52, 59, 61, 62.
344. *N. perpusilla* Grun. Samples 25, 27, 28.
345. *N. pupula* Kg. Samples 46, 54, 56, 60, 61, 62, 63, 64.
346. *N. pupula* var. *capitata* Hust. Samples 47, 48, 49, 50, 55, 64.
347. *N. pupula* var. *rectangularis* (Greg.) Grun. Sample 63.
348. *N. pygmaea* Kg. Samples 59, 60.
349. *N. radiosa* Kg. Samples 7, 8, 11, 12, 46, 47, 48, 52, 53, 54, 55, 57, 58, 63, 64.
350. *N. radiosa* var. *tenella* (Bréb.) Grun. Samples 9, 11, 25, 32, 33, 35, 45, 47, 48, 49, 50, 52, 54, 55, 57, 58, 59, 60, 63, 64.
351. *N. rhynchocephala* Kg. Samples 7, 13, 14, 15, 48, 60.
352. *N. ruttneri* Hust. Sample 33.
353. *N. schroeteri* Meister. Samples 1, 7, 9, 10, 12, 14, 47, 48, 50.
354. *N. seminuloides* Hust. Sample 7.
355. *N. seminuloides* var. *sumatrana* Hust. Samples 29, 45.
356. *N. seminulum* Grun. Samples 29, 32, 33, 49, 59, 60.
357. *N. simplex* Krasske var. *minor* Chy. Samples 20, 22, 23, 52, 53, 54, 55, 56, 58.
358. *N. subtilissima* Cl. Samples 3, 52, 56.
359. *N. suecorum* Carlson. Samples 19, 64.
360. *N. tenelloides* Hust. Samples 19, 21, 29, 31, 32, 33, 35, 45, 46, 62.
361. *N. terrestris* Petersen. Samples 63, 64.
362. *N. tridentula* Krasske. Sample 60.
363. *N. viridula* Kg. Samples 1, 60.
364. *N. viridula* var. *linearis* Hust. Sample 1.
365. *N. viridula* var. *rostellata* (Kg.) Cl. Samples 5, 6, 7, 9, 10, 11, 12, 13, 14, 15, 16, 18, 19, 20, 23, 28, 47, 48, 49, 50, 51, 60, 62, 63, 64.
366. *N. vulpina* Kg. Sample 59.
367. *N. zanoni* Hust. Samples 1, 5, 7, 8, 9, 10, 11, 12, 13, 47, 50.

Pinnularia *Ehrenberg*

368. *P. acoricola* Hust. Samples 25, 29, 45.
369. *P. acrosphaeria* Bréb. Samples 5, 14, 15, 59.
370. *P. acrosphaeria* var. *controversa* Chy. Sample 59.
371. *P. amaniensis* Hust. Samples 25, 26, 28.
372. *P. borealis* E. Sample 23.
373. *P. braunii* (Grun.) Cl. Samples 54, 58.
374. *P. braunii* var. *amphicephala* (A. Mayer) Hust. Sample 45.
375. *P. claasseniae* Chy. Sample 35.
376. *P. dactylus* E. Sample 45.
377. *P. divergens* W. Sm. Samples 14, 15, 20, 47, 50, 54.
378. *P. divergens* var. *undulata* Hérib. & Perag. Sample 13.
379. *P. dubitabilis* Hust. Samples 2, 3, 12, 20, 24, 25, 27, 28, 29, 33, 35, 45, 47, 48, 53, 55, 57, 60, 63, 64.

380. *P. gibba* E. Samples 6, 7, 11, 14, 15, 20, 25, 26, 27, 28, 29, 33, 45, 46, 47, 48, 49, 50, 51, 52, 54, 56, 57, 58, 59, 61, 63, 64.
381. *P. gibba* forma *subundulata* Mayer. Samples 16, 31, 33, 47, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 63, 64.
382. *P. gibba* var. *parva* (E.) Grun. Samples 4, 7, 9, 11, 13, 14, 15, 19, 25, 26, 27, 28, 29, 31, 33, 35, 45, 51, 63, 64.
383. *P. gibba* var. *sancta* Grun. Samples 25, 28, 33, 50, 51, 54, 55, 56, 59, 63.
384. *P. graciloides* Hust. Samples 4, 23.
385. *P. interrupta* W. Sm. Samples 23, 25, 26, 27, 28, 29, 32, 33, 63.
386. *P. interrupta* var. *minutissima* Hust. Samples 7, 24.
387. *P. maior* (Kg.) Cl. Samples 13, 14, 15, 58.
388. *P. mesolepta* (E.) W. Sm. Sample 19.
389. *P. microstauron* (E.) Cl. Sample 64.
390. *P. microstauron* forma *biundulata* O.M. Sample 48.
391. *P. microstauron* var. *brébissonii* (Kg.) Hust. Sample 19.
392. *P. ruttneri* Hust. Samples 25, 28.
393. *P. subcapitata* Greg. Samples 2, 3, 9, 12, 19, 20, 22, 23, 25, 27, 28, 29, 31, 32, 33, 34, 35, 45, 50, 51, 52, 53, 54, 55, 60, 64.
394. *P. subcapitata* var. *hilseana* (Janisch) O.M. Samples 2, 4, 7, 10, 11, 12, 25, 28, 31, 32, 33, 34, 35, 45, 46, 48, 50, 51, 52, 53, 54, 55, 56, 57.
395. *P. viridis* (Nitzsch) E. Samples 4, 12, 13, 14, 15, 16, 20, 27, 28, 33, 47, 48, 49, 50, 52, 53, 54, 56, 57, 58, 59, 63, 64.
396. *P. viridis* var. *sudetica* (Hilse) Hust. Sample 33.

Subfam.: Amphiproroideae.

Amphora *Ehrenberg*

397. *A. ovalis* Kg. Samples 12, 14, 59.
398. *A. ovalis* var. *libyca* (E.) Cl. Samples 47, 48, 49, 50.
399. *A. submontana* Hust. Samples 11, 13, 14, 15, 16, 23, 46, 47, 48, 49, 50, 62.

Cymbella *Agardh.*

400. *C. amphicephala* Näg. Sample 29.
401. *C. amphicephala* var. *hercynica* (N.S.) Cl. Sample 26.
402. *C. bengalensis* Grun. Sample 63.
403. *C. cistula* (Hempr.) Grun. Samples 5, 6, 7, 8, 9, 14.
404. *C. cistula* var. *africana* Chy. Samples 11, 12.
405. *C. claasseniae* Chy. Samples 25, 26, 28, 51, 54, 56, 58.
406. *C. gracilis* (Rabh.) Cl. Samples 7, 14, 15, 52.
407. *C. javanica* Hust. Sample 32.
408. *C. kappii* Chy. Samples 1, 5, 7, 8, 9, 10, 11, 12.
409. *C. kolbei* Hust. Samples 1, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 18, 20, 47, 50, 63, 64.
410. *C. microcephala* Grun. Samples 1, 2, 3, 5, 7, 8, 9, 10, 11, 12, 13, 20, 23, 45, 51, 52, 53, 54, 55, 56, 57, 58, 63, 64.
411. *C. mülleri* (O.M.) Hust. Sample 7.
412. *C. naviculiformis* Auersw. Samples 13, 14, 18, 51, 52, 53, 54, 55, 56, 57, 58, 63, 64.
413. *C. nylstroomensis* Chy. Sample 63.
414. *C. pretoriensis* Chy. Samples 21, 24, 25, 26, 27, 28, 29.
415. *C. pseudoincerta* Chy. Sample 29.
416. *C. raytonensis* Chy. Samples 22, 25, 26, 27, 28, 29, 52.
417. *C. raytonensis* var. *debegenica* Chy. Sample 21.
418. *C. spicula* Hust. Sample 64.
419. *C. spuria* Cl. Samples 8, 46.

420. *C. turgida* (Greg.) Cl. Samples 1, 2, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 18, 20, 23, 34, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 63, 64.
421. *C. turgida* forma *minor* Chy. Samples 7, 22, 23, 50, 52, 53, 55, 57, 58, 59, 60, 63.
422. *C. turgida* var. *pseudogracilis* Chy. Sample 63.
423. *C. ventricosa* Kg. Samples 1, 5, 7, 8, 9, 10, 11, 12, 13, 18, 19, 20, 22, 23, 29, 32, 33, 34, 35, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64.

Gomphonema *Agardh.*

424. *G. acuminatum* E. var. *turris* (E.) Cl. Sample 7.
425. *G. augur* E. Sample 52.
426. *G. clevei* Fricke. Samples 9, 50, 63, 64.
427. *G. constrictum* E. Samples 57, 60, 63, 64.
428. *G. gracile* E. Samples 1, 4, 6, 7, 8, 9, 11, 12, 13, 14, 15, 18, 23, 24, 25, 26, 28, 29, 32, 46, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 63, 64.
429. *G. gracile* var. *lanceolatum* (Kg.) Cl. Samples 7, 9, 12, 51, 59, 60, 63, 64.
430. *G. lanceolatum* E. Samples 4, 5, 6, 9, 10, 11.
431. *G. parvulum* (Kg.) Grun. Samples 2. 4, 5, 6, 7, 8, 9, 10, 11, 13, 14, 15, 16, 20, 23, 26, 29, 32, 33, 35, 45 46. 47, 48, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 63, 64.
432. *G. parvulum* var. *lagenula* (Grun.) Hust. Samples 1, 2, 4, 5, 9, 10, 11, 12, 13, 14, 18, 19, 20, 21, 22, 23, 24, 25, 28, 29, 31, 32, 33, 34, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 63, 64.
433. *G. subtile* E. Samples 7, 26, 28, 33.

Fam.: Epithemiaceae.

Subfam.: Epithemioideae.

Epithemia *Brébisson*

434. *E. zebra* (E.) Kg. Sample 7.

Subfam.: Rhopalodioideae.

Rhopalodia *O. Müller*

435. *R. gibba* (E.) O.M. Samples 4, 6, 9, 11, 12, 13, 14, 23, 47, 48, 49, 50, 62.

Fam.: Nitzschiaceae.

Subfam.: Nitzschioideae.

Hantzschia *Grunow*

436. *H. amphioxys* (E.) Grun. Samples 11, 12, 17, 20, 23, 33, 56, 59, 60, 62, 64.
437. *H. amphioxys* var. *africana* Hust. forma *minuta* Chy. Samples 1, 3, 4, 21, 25, 26, 27, 28, 29, 31, 34, 35, 48, 49, 51, 52, 55, 57, 58, 63.
438. *H. amphioxys* var. *intermedia* Grun. Samples 20, 57, 58, 59, 63.
439. *H. amphioxys* var. *vivax* (Hantzsch) Grun. Samples 20, 26, 27, 29, 47, 48, 49, 53, 55, 56, 57, 59.

Nitzschia *Hassal*

440. *N. accommodata* Hust. Samples 1, 3, 4, 5, 6, 7, 8, 9, 10, 12, 13, 14, 15, 16, 17, 20, 22, 23, 25, 26, 27, 28, 32, 33, 34, 46, 47, 48, 49, 51, 53, 54, 58, 59, 60, 61, 62, 63.
441. *N. amphibia* Grun. Samples 48, 50.
442. *N. capitellata* Hust. Samples 1, 33, 46, 47, 48, 51, 52, 53, 54, 55, 56, 57, 58, 62, 64.

443. *N. claasseniae* Chy. Samples 1, 5, 7, 12, 20, 23, 57, 58, 59, 60.
444. *N. clausii* Hantzsch. Samples 1, 13, 14, 15, 18, 47, 50, 63.
445. *N. confinis* Hust. Samples 7, 13, 48.
446. *N. debilis* (Arnott) Grun. Sample 63.
447. *N. denticula* Grun. Sample 22.
448. *N. diserta* Hust. Sample 5.
449. *N. dissipata* (Kg.) Grun. Samples 1, 16.
450. *N. fonticola* Grun. Samples 9, 13, 17, 19, 21, 23, 28, 29, 31, 32, 33, 34, 35, 45, 46, 49.
451. *N. frustulum* (Kg.) Grun. var. *perpusilla* (Rabh.) Grun. Samples 5, 12, 18, 19, 20, 22, 60.
452. *N. goetzeana* O.M. Samples 13, 14, 59.
453. *N. kützingiana* Hilse. Samples 46, 47, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62.
454. *N. linearis* (Ag.) W. Sm. Samples 1, 5, 7, 9, 11, 13, 14, 15, 16, 47, 48, 49, 50, 51, 59, 60, 62, 64.
455. *N. palea* (Kg.) W. Sm. Samples 2, 5, 11, 12, 24.
456. *N. palea* var. *tropica* Host. Sample 49.
457. *N. purvuloides* Chy. Samples 21, 26, 32, 45, 53.
458. *N. perminuta* Grun. Samples 46, 53, 55, 56, 58, 59, 60, 61, 62.
459. *N. pseudobacata* Chy. Sample 47.
460. *N. recta* Hantzsch. Sample 1.
461. *N. romana* Grun. Sample 59.
462. *N. sigma* (Kg.) W. Sm. Samples 1, 20, 23, 47, 48, 50.
463. *N. subadapta* Chy. Sample 12.
464. *N. subcommunis* Hust. Sample 50.
465. *N. subvitrea* Hust. Samples 14, 47, 49.
466. *N. tarda* Hust. Samples 8, 20, 23, 47, 49, 55, 56, 59, 60.
467. *N. transvaalensis* Chy. Sample 59.
468. *N. tropica* Hust. Samples 1, 4, 19, 20, 22, 23.
469. *N. tryblionella* Hantzsch var. *levidensis* (W. Sm.) Grun. Samples 1, 7, 59.
470. *N. von-hauseniae* Chy. Samples 20, 25, 26, 32, 33, 63, 64.

Fam.: Surirellaceae.

Subfam.: Surirelloideae.

Cymatopleura *W. Smith*

471. *C. solea* (Bréb.) W. Sm. Samples 12, 14.

Stenopterobia *Brébisson*

472. *S. intermedia* (Lewis) Hust. Samples 25, 26, 27, 28, 46.
473. *S. rautenbachiae* Chy. Sample 64.

Surirella *Turpin*

474. *S. angusta* Kg. Samples 1, 7, 13, 14, 15, 20, 47, 48, 50, 59, 60, 61, 62, 63, 64.
475. *S. delicatissima* Lewis. Samples 22, 24, 26, 27, 28, 32, 34, 35, 45, 51, 52, 53, 54, 55, 56, 57, 58, 63, 64.
476. *S. linearis* W. Sm. Samples 1, 46, 56, 58, 64.
477. *S. robusta* E. var. *splendida* (E.) van Heurck. Sample 48.
478. *S. tenera* Greg. Samples 1, 7, 13, 14, 20, 23, 29, 45, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58.
479. *S. tenera* forma *minor* Chy. Sample 64.

TRIBUS: EUTHALLOPHYTA

Class: Chlorophyceae.

Order: Protococcales.

Fam.: Hydrodictyaceae.

Pediastrum *Meyen.*

480. *P. boryanum* (Turpin) Menegh. var. *granulatum* (Kütz.) Al Braun. (Pascher Süsswasser-Flora, Heft 5, 1915, p. 101, fig. 61e.) This agrees in shape and size with var. *granulatum* Al Braun, but no granules were perciptible. (Tab. 33, fig. 4.) Sample 20.

481. *P. boryanum* var. *longicorne* Reinsch. (Pascher Süsswasser-Flora, Heft 5, 1915, p. 101, fig. 61d.) Sample 20.

482. *P. boryanum* var. *minor* var. nova, *P. boryano* var. *forcipato* Racib. affinis, sed membrana cellulae neque granulata neque punctata facile distinguenda.

Near var. *forcipatum* Racib. (Pascher Süsswasser-Flora, Heft 5, 1915, p. 101, fig. 61f); but the membrane is not granular or punctate. Colonies with 16–31 cells, margin-cells 6–8 μ in diameter; cells 8–11 μ long and 5–6 μ broad. (Tab. 33, fig. 5.) Samples 18, 20.

483. *P. duplex* Meyen var. *reticulatum* Lagerheim. (Pascher Süsswasser-Flora, Heft 5, 1915, p. 95, fig. 57h.) Sample 47.

484. *P. duplex* var. *reticulatum* forma *cohaerens* Bohlin. (Pascher Süsswasser-Flora, Heft 5, 1915, p. 95, fig. 57f.) (Tab. 33, figs. 1–3.) Sample 74.

485. *P. tetras* (Ehrenb.) Ralfs forma *evoluta* West. Samples 47, 48.

486. *P. tetras* var. *excisum* Rabenh. (Pascher Süsswasser-Flora, Heft 5, 1915, p. 104, fig. 64b.) (Tab. 33, fig. 6.)

Fam.: Coelastraceae.

Scenedesmus *Meyen*

487. *Sc. bijugatus* (Turpin) Kütz. (Pascher Süsswasser-Flora, Heft 5, 1915, p. 167.) Samples 19, 23, 48.

488. *Sc. quadricauda* (Turpin) Bréb. (Pascher Süsswasser-Flora, Heft 5, 1915, p. 165, fig. 223.) Samples 12, 20, 23, 35, 47, 48.

Order: Ulotrichales.

Fam: Oedogoniaceae.

Oedogonium *Link.*

489. *Oe. boyanum* spec. nova, *Oe. crasso* Wittr. sec. Hirn affinis, sed plantae bisexuales, antheridia 3–16-cellulata, oogonia et oosporae latiores sunt.

This species is near *Oe. crassum* Wittr. sec. Hirn. (Pascher Süsswasserflora, Heft 6, 1914, p. 200, fig. 286); but the plants are monoecious, the antheridia have 3–16 cells and the oogonia and oospores are broader. Oogonia solitary, elliptical, with a pore in the upper part, 79–82 μ broad and 112–130 μ long. Oospores elliptical, not filling the oogonium, membrane smooth and thick, 74 μ broad and 91 μ long. Vegetative cells 52–54 μ broad and 96–192 μ long. Antheridium cells 44–48 μ broad and 6–12 μ long. (Tab. 34, figs. 9, 10.) Sample 73.

490. *Oe. mattiei* spec. nova, *Oe. zig-zag* Cleve sec. Hirn affinis, sed antheridiis 1–3-cellulatis, cellulis sterilibus latioribus, oogoniis brevioribus, zygotis globosis et oogonium haud complentibus, cellulis antheridii latioribus brevioribusque valde differt.

Near *Oe. zig-zag* Cleve sec. Hirn (Pascher Süsswasserflora, Heft 6, 1914, p. 209, fig. 304); but differs in that the oospore does not fill the oogonium, and in having broader vegetative cells, shorter oogonia, spherical oospores, and shorter, broader, 1-celled to 3-celled antheridia. Monoecious; oogonium solitary, more or less spherical, with a pore in the upper part, 44–50 μ broad and 43–52 μ long. Oospore membrane smooth and thick, 42 μ in diameter. Vegetative cells 28–30 μ broad and 40–72 μ long. Antheridium cells 26–28 μ broad and 6–8 μ long. (Tab. 34, fig. 8.) Sample 73.

491. *Oe. mesianum* spec. nova, *Oe. varians* Wittr. et Lund. sec. Hirn affinis, sed ternis vel quaternis antheridiorum cellulis, sterilibus cellulis paulo latioribus et zygotis multo minoribus facile distinguenda.

This species closely resembles *Oe. varians* Wittr. & Lund. sec. Hirn (Pascher Süsswasserflora, Heft 6, 1914, p. 206, fig. 298); but the antheridia consist of 3–4 cells, the vegetative cells are slightly broader and the oospores are considerably smaller. Monoecious; oogonia solitary, subovate, with a pore in the upper part, oogonia 36 μ broad and 38 μ long. Oospores spherical, not filling the oogonia, membrane smooth and fairly thick, 27 μ in diameter. Vegetative cells 16–20 μ broad and 44–80 μ long. Antheridium cells 15 μ broad and 3–8 μ long. (Tab. 34, fig. 5.) Sample 20.

Named after the late Prof. Dr. M. G. Mes, formerly Head of the Department of Plant Physiology and Biochemistry, University of Pretoria.

492. *Oe. pseudofragile* spec. nova, ex affinitate *Oe. fragile* Wittr. sec. Hirn. Differt tamen eo quod antheridiis ternae, quaternae vel quinae sunt cellulae, oogonia et oosporae minora sunt et antheridii cellulae breviores.

Near *Oe. fragile* Wittr. sec. Hirn (Pascher Süsswasserflora, Heft 6, 1914, p. 207, fig. 302); but the antheridia consist of 3–5 cells, the oogonia and oospores are smaller and the antheridium cells are shorter. Monoecious; oogonia solitary, more or less spherical, with a pore in the upper part, 36–38 μ broad and 32–36 μ. Oospores not filling the oogonia, more or less spherical, membrane smooth and fairly thick, 32 μ broad and 30–32 μ long. Vegetative cells 12–20 μ broad and 44–80 μ long. Antheridium cells 12–16 μ broad and 4–6 μ long. (Tab. 34, figs. 1–4.) Sample 20.

493. *Oe. subintermedium* spec. nova, affinis *Oe. intermedio* Wittr. sec. Hirn, sed differt quod oogonium in parte superiore angustatum, cellulae steriles paulo latiores, cellulae antheridii paulo et latiores et longiores sunt quam in *Oe. intermedio*.

This is near *Oe. intermedium* Wittr. sec. Hirn (Pascher Süsswasserflora, Heft 6, 1914, p. 207, fig. 301); but the upper part of the oogonium is attenuated, the vegetative and antheridium cells are slightly broader and the antheridium cells are slightly longer. Monoecious; oogonia solitary, more or less spherical, with a pore in the upper part, 34 μ broad and 33 μ long. Oospore more or less spherical, not filling the oogonium, membrane smooth, 30 μ broad and 28 μ long. Vegetative cells 20 μ broad and 60–80 μ long. Antheridia 2-celled, 19 μ broad and 10–12 μ long. (Tab. 34, fig. 6.) Sample 73.

494. *Oe. subvaucherii* spec. nova, *Oe. vaucherio* A. Braun sec. Hirn affinis, sed oogoniis globosis differt.

This differs from *Oe. vaucherii* A. Braun sec. Hirn (Pascher Süsswasserflora, Heft 6, 1914, p. 207, fig. 303) in the oogonia being spherical. Monoecious; oogonium solitary, spherical, with a pore in the upper part, 46 μ in diameter. Oospore spherical, not filling the oogonium, membrane smooth and thick, 40 μ in diameter. Vegetative cells 22 μ broad and 60–80 μ long. Antheridia 2–4-celled, 19 μ broad and 6–8 μ long. (Tab. 34, fig. 7.) Sample 73.

III.—VEGETATIVE REPRODUCTION IN DESMIDS

In Desmids vegetative reproduction takes place by cell division. In the genera possessing a median constriction the two semicells move apart during the elongation of the isthmus which is accompanied or followed by nuclear division. Normally the next step is the formation of a cylindrical girdle band within the wall in the median region of the elongated isthmus. In exceptional cases the girdle band is not formed during every cell division; in some species the girdle band is consistently absent. From this girdle band a plate-like projection grows inwards and eventually becomes the cross-partition. Simultaneously the elongated isthmus-halves begin to swell and develop into new semicells. During this process of swelling the chloroplasts of the parent semicells elongate, divide and take up their position in the newly formed semicells. Finally, the cross-partition splits and the newly formed individuals move apart.

Cell division does not always take place in the normal manner in vitro: it was observed that an individual in which one of the semicells had not reached full maturity was capable of dividing again, so that the daughter individuals differed markedly in shape and size from the normal type. (See Tab. 13, fig. 3; Tab. 21, figs. 1, 4; Tab. 22, figs. 5, 6; Tab. 23, fig. 1.)

During August, 1955, cell division was studied in two species of *Micrasterias*. It was observed that the chloroplasts of individuals about to divide were a deeper green colour than those of resting individuals.

The rate and manner of cell division in *Micrasterias crux-melitensis* (Ehrenb.) Hass. are illustrated in Tab. 35, figs. A–P. Similar observations on *Micrasterias denticulata* Bréb. are presented in Tab. 36, figs. A–G and Tab. 37, figs. H–K.

Cell division usually begins during the afternoon. The first divisional stages are reached fairly rapidly; but it may take up to several days before the new semicells reach their mature size, normal shape and effiguration.

Not infrequently however, patterns deviating from the normal are met with. For instance, the cross septum may not be completed, and the swelling isthmus develops curiously shaped monstrosities between the two adjacent parent semicells.

Rosenberg (1940) studied the effect of various sets of conditions on zygospore formation in desmids. He worked mainly with *Micrasterias americana* (Ehrenb.) Ralfs. He found that a low rate of division was obtained by growing this species in Benecke's nutrient solution (250 p.p.m.) in the dark at a low temperature of 8°C. After 10 days, he examined the cultures and found that about 10 per cent of the cells were abnormally large and contained an additional section between the two halves which normally join at the isthmus. When these giant cells were isolated and placed under conditions favouring rapid division, each cell divided at both isthmuses simultaneously, giving rise to one giant cell and two normal cells. The results of several series of experiments showed that giant cell formation takes place when conditions are unfavourable for cell division, for instance during the winter.

In the material collected in the districts of Warmbaths, Nylstroom and Naboomspruit giant cells were observed in: *Euastrum insulare* (Wittr.) Roy (Tab. 9, fig. 12); *Micrasterias crux-melitensis* (Ehrenb.) Hass. (Tab. 21, fig. 4; Tab. 22, figs. 1–3); *Cosmarium sexnotatum* Gutw. var. *simplex* Claassen (Tab. 24, fig. 9); *C. waterbergense* Claassen (Tab. 26, figs. 4–7) and *Staurastrum dilatatum* Ehrenb. (Tab. 30, fig. 6). The material of *M. crux-melitensis* was collected during August, 1955 and that of the other four species during April, 1954.

As only mature giant cells were observed, and not their actual formation, it was not possible to determine whether those in *M. crux-melitensis* were the result of a very low division rate or not. It should be mentioned that numerous other variations in this species were observed to arise during very rapid division. The material containing giant cells of the other four species was fixed at the time of collecting.

Numerous variations were observed among the specimens of *M. crux-melitensis* (Ehrenb.) Hass. The normal type is illustrated in Tab. 18, figs. 1, 2 and the following figures depict the majority of the variations: Tab. 18, figs. 3–14; Tab. 19, figs. 1–11; Tab. 20, figs. 1–6; Tab. 21, figs. 1–4; Tab. 22, figs. 1–6; Tab. 23, fig. 1.

G. S. West (1899) in discussing variation in the Desmidieae, states:

" The ordinary method of increase in this family (Desmidiaceae) of unicellular plants is by division of the mother-cell into two exactly similar daughter-cells, each constituted of one of the half-cells of the mother and a newly developed half. The latter is sometimes markedly different from the parent half, but in cases where this difference is extreme the new halves of the next division generally conform to the original type, though more rarely this may not occur for several generations.

The great diversity of form and wonderfully varied character of these plants are to be associated with their confinement to small ponds or the quiet margins of lakes, &c., localities suitable for their existence in large numbers. In these restricted areas the unceasing effect of the struggle for existence will result in a gradually increasing diversity of form, and this is to be correlated with the immense numbers of individuals that are sometimes found in these situations.

As regards the conditions favourable to variation among the members of this group of plants, it may be said that the occurrence in large quantity of a particular species is most conducive to the production of deviations from the normal form. It may happen that in some localised spot an immense quantity of some particular species is occasionally produced by very rapid division, and in such a case some variation is always met with".

The foregoing facts were found to be applicable to fresh material of *Micrasterias crux-melitensis* (Ehrenb.) Hass. kept in glass containers and studied from 12/7/55 onwards. It was observed in numerous individuals that where there were differences between the new semicells and the parent semicells, the semicells formed during the next division reverted to the original type (Tab. 18, fig. 7; Tab. 19, fig. 7; Tab. 21, figs. 1, 3).

West (1899) also states:

" The most numerous variations are to be found amongst the commoner and more widely distributed species. The majority of these variations appear to affect only the superficial characters—the warts, spines, striolations, granules, scrobiculations, &c., on the external or internal surfaces of the cell-wall. Some of them, however, are more important modifications, being changes in the external form of symmetry of the plant; and yet others are variations in the structure and arrangement of the cell-contents.

That variation in a species has a tendency to be reproduced there can be no doubt, especially when the reproduction takes place, as in these plants, by simple cell-division; yet extreme modifications, which are obvious abnormalities, are never (or very rarely) repeated in succeeding generations and may be regarded merely as accidental occurrences in the history of species.

The five statements which follow represent the result of the direct observations on variation in this group of plants, and may, owing to our insufficient knowledge of the question, be subject to further alterations.

1. The structure of the cell-contents is one of the most constant features exhibited by a species; but this fact can be of little classificatory value owing to the very large number of species which possess the same structure and arrangement of the chromatophores.

2. The outward form of the cell, as seen in front view, varies within certain limits, which are usually very small, but which may in exceptional cases be considerable. The form of the vertical view is, as a rule, a more constant feature than the form of the front view.
3. The ornamentation (scrobiculations, granulations, spinulations, &c.) of the cell-wall is relatively constant, being always arranged according to a definite law, which is only transgressed by variations in one or more of the individual component groups which constitute the pattern of arrangement.
4. The prolific growth and rapid division of immense numbers of Desmids have a tendency to produce variations from the typical forms.
5. Changes in the conditions of environment cannot affect the characters of a species unless they act for long periods of time".

Abnormal cell division was also observed in two species of *Cosmarium* viz. Tab. 28, fig. 3 and Tab. 29, fig. 4.

IV.—SUMMARY

The freshwater algal flora of the districts of Warmbaths, Nylstroom and Naboomspruit in South Africa has been investigated. A total of 494 species, varieties and forms have been identified. These include 17 Cyanophyceae with seven genera, two Flagellatae with two genera, four Mesotaeniaceae with two genera, 207 Desmidiaceae with 12 genera, 249 Diatomeae with 26 genera and 15 Chlorophyceae with three genera. Thus in the material studied, the Desmidiaceae and Diatomeae are best represented.

Several of the taxa in the present communication are new records for South Africa.

The diatom taxa have been studied in detail by Dr. B. J. Cholnoky and are only mentioned in the taxonomic part for the sake of completeness as regards the survey of the freshwater algal flora of the region under consideration. Of the 245 other taxa, 157 are described as new species, varieties or forms, as indicated in Table I.

TABLE I.—*The Numbers of Species, Subspecies, Varieties and Forms belonging to the Different Groups*

	Total Spp.	New Spp.	Total Subspp.	Total Varieties	New Varieties	Total Forms	New Forms
Cyanophyceae	17	10	—	—	—	—	—
Flagellatae	1	—	—	1	1	—	—
Mesotaeniaceae	3	2	—	1	—	—	—
Desmidiaceae	100	46	1	95	84	11	7
Chlorophyceae	8	6	—	5	1	2	—
TOTALS	129	64	1	102	86	13	7

From the investigation of this relatively small area in South Africa, it is clear that—

(1) new taxa are abundant in this area;

(2) additional taxa from this area await description since several of these were in a condition that did not permit identification;

(3) further investigation is of the utmost importance if a relatively complete survey of the freshwater microflora of this area is aimed at. In this respect a closer study of the Cyanophyceae, Flagellatae, Chlorophyceae, Zygnemales and the smaller forms of the Desmidiaceae should be undertaken.

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* This area is situated in N.W. Transvaal.

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EXPLANATION OF THE ILLUSTRATIONS.

FIGURE 1.

Topographical Map of the districts of Warmbaths, Nylstroom and Naboomspruit showing the principal localities where collections were made.

FIGURE 2.

Localities of collections in the Doornfontein and Leeupoort area.

FIGURE 3.

Localities of collections in the Moddernek area.

TABULA 1

FIGS.

1, 2. *Stigonema pseudominutum* sp. nov.
3–7. *Scytonema myochrous* (Dillw.) Ag.

TABULA 2

FIGS.

1. *Nostoc pseudogelatinosum* sp. nov.
2. *N. nylstromicum* sp. nov.
3. *Anabaena galpinii* sp. nov.
4. *A. mesiana* sp. nov.
5. *A. pseudocatenula* sp. nov.
6. *Oscillatoria subpristleyi* sp. nov.
7. *O. nylstromica* sp. nov.
8. *O. tenuis* Ag.
9. *O. waterbergensis* sp. nov.
10. *Lyngbya uliginosa* sp. nov.

Figs. 3, 4 × a; 5, 6, 7, 9 × b; 1, 2, 8, 10 × c.

TABULA 3

FIGS.

1. *Cylindrocystis barbarica* sp. nov.
2. *C. caffra* sp. nov.
3. *Penium margaritaceum* (Ehrenb.) Bréb.
4. *P. margaritaceum* var. *incognitum* var. nov.
5. *P. margaritaceum* var. *brevior* var. nov.
6. *P. barbaricum* sp. nov.
7. *P. libellula* (Focke) Nordst. var. *schweickerdtii* var. nov.
8. *P. subcucurbitinum* sp. nov.
9. *P. curtum* Bréb. var. *waterbergense* var. nov.
10–13. *P. mesianum* sp. nov.
14. *P. pseudorufescens* sp. nov.
15. *P. curcurbitinum* Biss. forma *botesii* forma nov.
16, 17. *Penium* species ad *P. cruciferum* (De Bary) Wittr. Fig. 17 = zygospore.

Figs. 4, 5, 6, 7, 10, 11, 13 × a; 1, 2, 3, 8, 9, 12, 14, 15, 16, 17 × b.
a = 40 μ; b = 40 μ.

Tabula 4

Figs.

1. *Closterium pseudolunula* sp. nov.
2. *C. spetsbergense* Borge var. *subafricanum* var. nov.
3. *C. intermedium* Ralfs var. *mesianum* var. nov.
4–5. *C. kranskopense* sp. nov.
6–7. *C. acerosum* (Schrank) Ehrenb. var. *waterbergense* var. nov.
8–11. *C. malinvernianum* De Not.

Figs. 1, 3, 4, 8, 9, 10, 11 × a; 6 × b; 5, 7 × c; 2 × d.

Tabula 5

Figs.

1. *Closterium ralfsii* Bréb. var. *subralfsii* var. nov.
2. *C. ralfsii* var. *glentigianum* var. nov.
3. *C. ralfsii* var. *nodosum* var. nov.
4–5. *C. ralfsii* var. *minor* var. nov.
6. *C. truncatum* sp. nov.
7. *C. subsiliqua* sp. nov.
8. *C. pseudoleibleinii* sp. nov.
9. *C. striolatum* Ehrenb. var. *nylstromicum* var. nov.
10. *C. striolatum* var. *subnylstromicum* var. nov.
11. *C. subdecorum* sp. nov.
12. *C. decorum* Bréb. var. *minor* var. nov.
13. *C. boyanum* sp. nov.
14. *C. moniliferum* (Bory) Ehrenb. var. *epithemioides* var. nov.
15. *C. cymbellaeformis* sp. nov.
16. *C. atomicum* sp. nov.
17. *C. sublagoense* sp. nov.
18. *C. schweickerdtii* sp. nov.

Figs. 1, 2, 3 × a; 4, 5, 6, 7, 8, 9, 10, 13, 14, 15, 18 × b; 11, 12, 16, 17 × c.

Tabula 6

Figs.

1. *Closterium kützingii* Bréb. var. *transvaalense* var. nov.
2. *C. warmbadianum* sp. nov.
3. *C. warmbadianum* var. *porulosum* var. nov.
4–6. *C. barbaricum* sp. nov.
7. *C. jenneri* Ralfs var. *dubitabilis* var. nov.
8. *C. parvulum* Näg. var. *minor* var. nov.
9–10. *C. abruptum* West var. *westiorum* var. nov.
11. *C. peracerosum* Gay var. *elegans* G. S. West.
12. *C. gracile* Bréb. var. *brevius* var. nov.
13. *C. tumidum* Johnson var. *angustum* var. nov.
14. *C. ceratium* Perty var. *angustum* var. nov.
15. *C. tumidum* Johnson.
16–18. *C. venus* Kütz. var. *inflatum* var. nov.
19. *C. incurvum* Bréb. var. *elaboratum* var. nov.
20. *C. calosporum* Wittr. var. *minor* var. nov.
21. *C. ehrenbergii* Menegh. var. *minutissimum* var. nov.
22. *C. acutum* (Lyngb.) Bréb. var. *linea* (Perty) W. & G. S. West forma *minor* f. nov.
23. *C. cornu* Ehrenb. var. *minor* var. nov.
24. *C. cornu* var. *angustum* var. nov.

Figs. 4, 5, 6, 7, 8, 9, 10, 11, 13, 14, 17, 18, 20, 24 × a; 2, 3, 12, 15, 16, 19, 21, 22, 23 × b; 1 × c.
a = 40 μ; b = 40 μ.

Tabula 7

Figs.

1. *Pleurotaenium trabecula* (Ehrenb.) Näg. var. *barbaricum* var. nov.
2. *Pl. pseudoehrenbergii* var. nov.
3–5. *Pl. trabecula* (Ehrenb.) Näg. var. *angustum* var. nov.
6. *Pl. caffrorum* sp. nov.
7–8. *Pl. ehrenbergii* (Bréb.) De Bary var. *waterbergense* var. nov.
9. *Pl. westiorum* sp. nov.
10. *Pl. trabecula* var. *brevis* var. nov.

Figs. 7, 8 × a; 1, 2, 3, 4, 5, 10 × b; 9 × c; 6 × d.

Tabula 8

Figs.

1, 2. *Pleurotaenium* species ad *Pl. ovatum* Nordst.
3. *Closterium cynthia* De Not var. *waterbergense* var. nov.
4. *C. caffrorum* sp. nov.
5. *C. insolitum* sp. nov.
6. *Pleurotaenium truncatum* (Bréb.) Näg. var. *mattiei* var. nov.
7. *Pl. trochiscum* W. & G. S. West var. *galpinii* var. nov.

Figs. 1, 2 × a; 3, 4, 5 × b; 6, 7 × c.

Tabula 9

Figs.

1. *Euastrum spinulosum* Delp. subsp. *africanum* Nordst.
2. *E. spinulosum* subsp. *africanum* var. *transvaalense* var. nov.
3. *E. divergens* Josh. var. *subbifidum* var. nov.
4–5. *E. rostratum* Ralfs subsp. *umbonatum* W. & G. S. West var. *kranskopense* var. nov.
6–7. *E. brasiliense* Borge var. *theronii* var. nov.
8. *E. ansatum* Ralfs.
9. *E. dubitabilis* sp. nov.
10–12. *E. insulare* (Wittr.) Roy.
13–14. *E. cuneatum* Jenner var. *minor* var. nov.
15–17. *E. pseudovalidum* sp. nov.
18. *E. elegans* (Bréb.) Kütz. var. *transvaalense* var. nov.
19–21. *E. schweickerdtii* sp. nov.

Figs. 1, 2, 3, 10, 11, 12, 13, 14 × a; 4, 5, 6, 7, 8, 9, 15, 16, 17, 18, 19, 20, 21 × b.

a = 40 μ; b = 40 μ.

Figs. 5, 7, 14, 16, 20 = lateral view of cell and figs. 17, 21 = vertical view of semicell.

Tabula 10

Figs.

1–4. *Micrasterias apiculata* (Ehrenb.) Menegh.

Figs. 1, 2 × a; 3, 4 × b.

Tabula 11

Figs.

1–4. *Micrasterias denticulata* Bréb. var. *africana* var. nov.

Figs. 1, 2 × a; 3, 4 × b.

TABULA 12

FIGS.
1. *Micrasterias denticulata* Bréb. var. *africana* var. nov.
2. *M. denticulata* var. *subnotata* West forma *cornuta* forma nov.
3. *M. nylstromica* sp. nov.

TABULA 13

FIGS.
1–3. *Micrasterias denticulata* Bréb. var. *subnotata* West forma *cornuta* forma nov.
4. *M. nylstromica* sp. nov.

TABULA 14

FIGS.
1–4. *Micrasterias groenewaldii* sp. nov.
Fig. 2 = vertical view of semicell.

TABULA 15

FIGS.
1–3. *Micrasterias truncata* (Corda) Bréb.
4, 5. *M. truncata* var. *africana* Fritsch & Rich.
6. *M. sol* (Ehrenb.) Kütz.
Figs. 1, 2, 3 × a; 4, 5, 6 × b.

TABULA 16

FIGS.
1, 2. *Micrasterias crux-melitensis* (Ehrenb.) Hass. var. *transvaalensis* var. nov.
3. *M. crux-melitensis* var. *evoluta* Turn.
4. *M. americana* (Ehrenb.) Ralfs var. *transvaalensis* var. nov.
5–7. *M. decemdentata* (Näg.) Arch.

TABULA 17

FIGS.
1. *Micrasterias crux-melitensis* (Ehrenb.) Hass. var. *evoluta* Turn.
2. *M. mahabuleshwarensis* Hobson var. *transvaalensis* var. nov.
3. *M. tropica* Nordst. var. *elongatissima* var. nov.
4–7. *M. decemdentata* (Näg.) Arch. var. *galpinii* var. nov.
8. *M. truncata* (Corda) Bréb. var. *minor* var. nov.

TABULA 18

FIGS.
1–14. *Micrasterias crux-melitensis* (Ehrenb.) Hass.
Fig. 2 = vertical view of semicell.

TABULA 19

FIGS.
1–11. *Micrasterias crux-melitensis* (Ehrenb.) Hass.

TABULA 20

FIGS.
1–6. *Micrasterias crux-melitensis* (Ehrenb.) Hass.

TABULA 21

FIGS.
1–4. *Micrasterias crux-melitensis* (Ehrenb.) Hass.

Tabula 22

Figs.
1–6. *Micrasterias crux-melitensis* (Ehrenb.) Hass.

Tabula 23

Figs.
1. *Micrasterias crux-melitensis* (Ehrenb.) Hass.
2, 3. *M. pinnatifida* (Kütz.) Ralfs var. *transvaalensis* var. nov.

Tabula 24

Figs.
1–3. *Euastrum divaricatum* Lund. var. *transvaalense* var. nov.
4–5. *Cosmarium pyramidatum* Bréb. var. *majus* var. nov.
6. *C. contractum* Kirchn. var. *pseudogartanense* var. nov.
7. *C. laeve* Rabenh. var. *majus* var. nov.
8, 9. *C. sexnotatum* Gutw. var. *simplex* var. nov.
10. *C. quadratum* Ralfs var. *africanum* Fritsch.
11. *C. decoratum* W. & G. S. West var. *waterbergense* var. nov.
12. *C. nanum* sp. nov.
13. *C. hammeri* Reinsch var. *minor* var. nov.
14, 15. *C. impressulum* Elfv.

Figs. 14 × a; 1–13, 15 × b.
Fig. 2 = lateral view and fig. 3 = vertical view of cell.
a = 40 μ; b = 40 μ.

Tabula 25

Figs.
1, 2. *Cosmarium pseudotaxichondrum* Nordst. var. *atomicum* var. nov.
3. *C. orthostichum* Lund. var. *pseudopumilum* var. nov.
4–6. *C. pseudoprotractum* sp. nov.
7, 8. *C. caffrorum* sp. nov.
9. *C. sexangulare* Lund.
10. *C. trachypleurum* Lund. var. *subspinosum* sp. nov.
11. *C. transvaalense* sp. nov.
12–14. *C. subcostatum* Nordst. var. *warmbadianum* var. nov.
15, 16. *C. debaryi* Arch. var. *minor* var. nov.
17, 18. *C. granatum* Bréb. var. *africanum* Fritsch.

Figs. 1, 2, 3, 9, 11, 18 × a; 4, 5, 6, 7, 8, 10, 12, 13, 14, 15, 16, 17 × b.
a = 40 μ; b = 40 μ.
Figs. 2, 6, 14, 16 = vertical view and fig. 5 = lateral view of cells.

Tabula 26

Figs.
1–7. *Cosmarium waterbergense* sp. nov.
8. *C. orthostichum* Lund. var. *transvaalense* var. nov.
9, 10. *C. speciosum* Lund. var. *simplex* Nordst. forma *africanum* forma nov.
11, 12. *C. tetragonum* (Näg.) Arch. var. *transvaalense* var. nov.
13. *C. nylstromicum* sp. nov.
14, 15. *C. subconnatum* sp. nov.
16. *Cosmarium barbaricum* sp. nov.

Figs. 8, 14, 15 × a; 1–7, 9–13, 16 × b.
Fig. 15 = lateral view of cell.

Tabula 27

Figs.

1, 2. *Cosmarium binum* Nordst.
3, 4. *C. botesii* sp. nov.
5. *C. maximum* (Börg.) W. & G. S. West var. *minor* West.
6. *C. trachypleurum* Lund. var. *pseudonatalensis* var. nov. forma *irregulare* f. nov.
7. *C. trachypleurum* var. *pseudonatalensis* var. nov.
8. *C. connatum* Bréb. var. *subellipticum* var. nov.
9. *C. subtumidum* Nordst. var. *theronii* var. nov.
10. *C. pyramidatum* Bréb. var. *elongatum* var. nov.

Figs. 1, 2, 4, 6 × a; 3, 5, 7–10 × b.

Fig. 2 = vertical view of semicell.

Tabula 28

Figs.

1–3. *Cosmarium obsoletum* (Hantzsch) Reinsch var. *transvaalense* var. nov.
4. *C. pachydermum* Lund. var. *waterbergense* var. nov.
5, 6. *C. reniforme* (Ralfs) Arch.
7–10. *Xanthidium cristatum* Bréb. var. *transvaalense* var. nov.

Figs. 1, 5, 6, 9, 10 × a; 2, 3, 4, 7, 8 × b.

Fig. 10 = vertical view of semicell.

Tabula 29

Figs.

1. *Euastrum galpinii* sp. nov.
2. *E. spinulosum* Delp. subsp. *africanum* Nordst.
3. *E. divergens* Josh. var. *galpinii* var. nov.
4. *Cosmarium granatum* Bréb. var. *africanum* Fritsch.
5, 6. *C. galpinii* sp. nov.
7, 8. *C. schweickerdtii* sp. nov.
9, 10. *C. pseudamoenum* Wille.
11. *C. decoratum* W. & G. S. West var. *galpinii* var. nov.
12. *Xanthidium cristatum* Bréb. var. *delpontei* Roy & Biss. forma *laevis* forma nov.
13, 14. *Staurastrum setigerum* Cleve var. *pectinatum* W. & G. S. West forma *australe* forma nov.
15–17. *St. galpinii* sp. nov.
18. *St. quadrangulare* Bréb. var. *subarmatum* var. nov.
19, 20. *St. brevispinum* Bréb. var. *masoganum* var. nov.

Figs. 6, 14, 15, 20 = vertical view of semicells.

Tabula 30

Figs.

1–6. *Staurastrum dilatatum* Ehrenb.
7–9. *St. caffrorum* sp. nov.
10, 11. *St. barbaricum* sp. nov.
12, 13. *St. xiphidiophorum* Wolle var. *westiorum* var. nov.
14, 15. *St. orbiculare* Ralfs var. *ralfsii* W. & G. S. West.
16–18. *St. subtrifurcatum* West forma *major* W. & G. S. West.

Figs. 16 × a; 14, 15, 17, 18 × b; 1–13 × c.

Figs. 3, 4, 8, 11, 12, 14, 18 = vertical view of semicells.

Tabula 31

Figs.
1, 2. *Staurastrum subgemmulatum* W. & G. S. West var. *mattiei* var. nov.
3, 4. *St. mesianum* sp. nov.
5, 6. *St. orbiculare* Ralfs var. *waterbergense* var. nov.
7, 8. *St. dickiei* Ralfs.
9, 10. *St. pseudogemmulatum* sp. nov.
11–13. *St. pseudogemmulatum* var. *warmbadianum* var. nov.
14–16. *St. dilatatum* Ehrenb.
17, 18. *St. trihedrale* Wolle var. *australe* var. nov.
19, 20. *St. teliferum* Ralfs var. *transvaalense* var. nov.
21, 22. *St. crenatum* var. nov.
23, 24. *St. connatum* Roy & Biss. var. *warmbadianum* var. nov.
25–27. *St. mattiei* sp. nov.
28, 29. *St. pygmaeum* Bréb. var. *botesii* var. nov.

Figs. 2, 4, 5, 7, 10, 11, 13, 15, 16, 17, 20, 22, 24, 26, 29 = vertical view of semicells.

Tabula 32

Figs.
1, 2. *Staurastrum gemelliparum* Nordst. var. *africanum* var. nov.
3–6. *St. furcatum* (Ehrenb.) Bréb.
7. *St. excavatum* W. & G. S. West.
8. *St. leptocladum* Nordst. var. *cornutum* Wille.
9. *Sphaerozosma aubertianum* W. West.
10. *Onychonema* species ad. *On. laeve* Nordst. var. *micracanthum* Nordst.
11. *Euglena spirogyra* Ehrenb. var. *major* var. nov.

Figs. 2, 4, 5 = vertical view of cells.

Tabula 33

Figs.
1–3. *Pediastrum duplex* Meyen var. *reticulatum* Lagerh. forma *cohaerens* Bohlin.
4. *P. boryanum* (Turpin) Menegh. var. *granulatum* (Kütz.) A. Br.
5. *P. boryanum* var. *minor* var. nov.
6. *P. tetras* (Ehrenb.) Ralfs var *excisum* Rabenh.

Figs. 1, 4, 5, 6 × a; 2, 3 × b.

Tabula 34

Figs.
1–4. *Oedogonium pseudofragile* sp. nov.
5. *Oe. mesianum* sp. nov.
6. *Oe. subintermedium* sp. nov.
7. *Oe. subvaucherii* sp. nov.
8. *Oe. mattiei* sp. nov.
9, 10. *Oe. boyanum* sp. nov.

Tabula 35

Figs.
a–p. *Micrasterias crux-melitensis* (Ehrenb.) Hass.

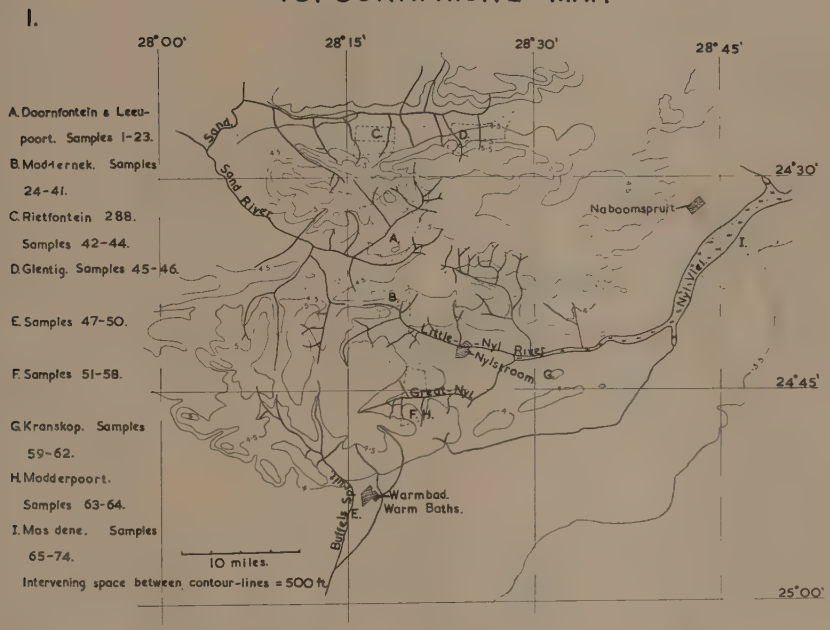
Tabula 36

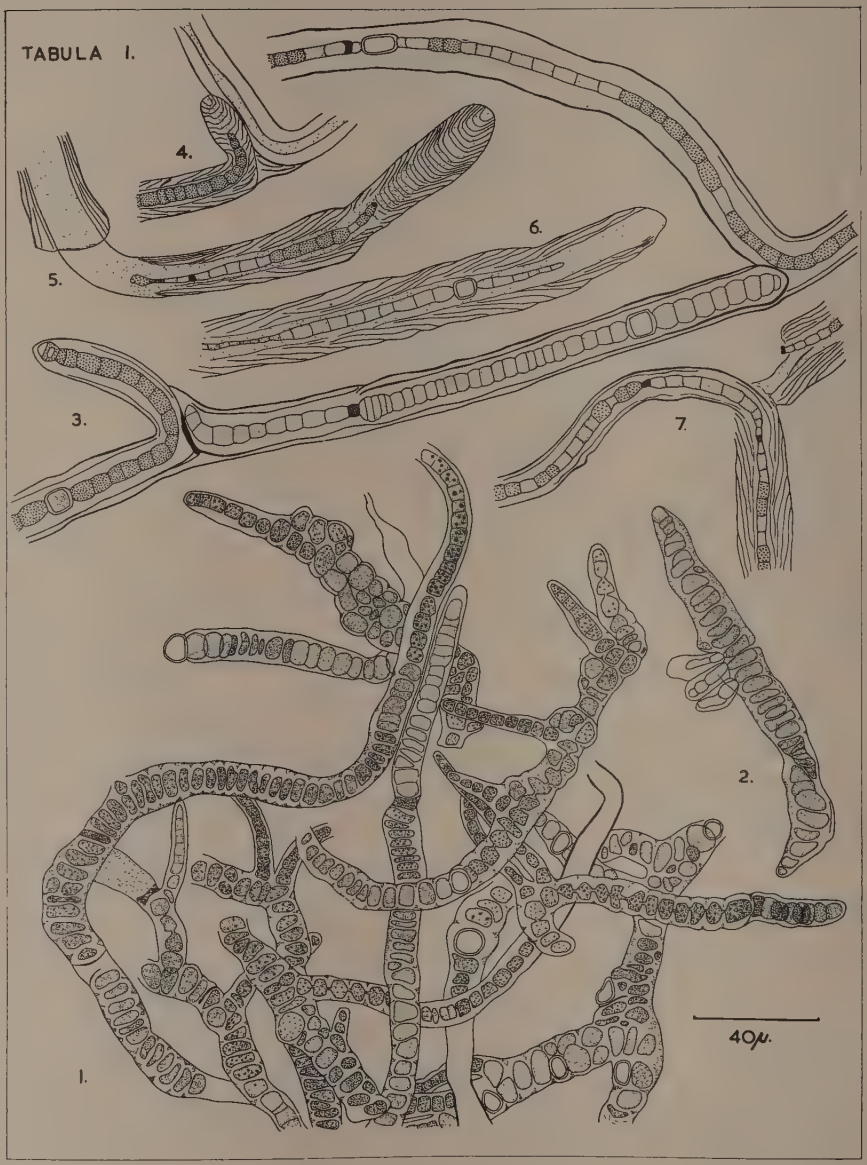
Figs.
A–G. *Micrasterias denticulata* Bréb.

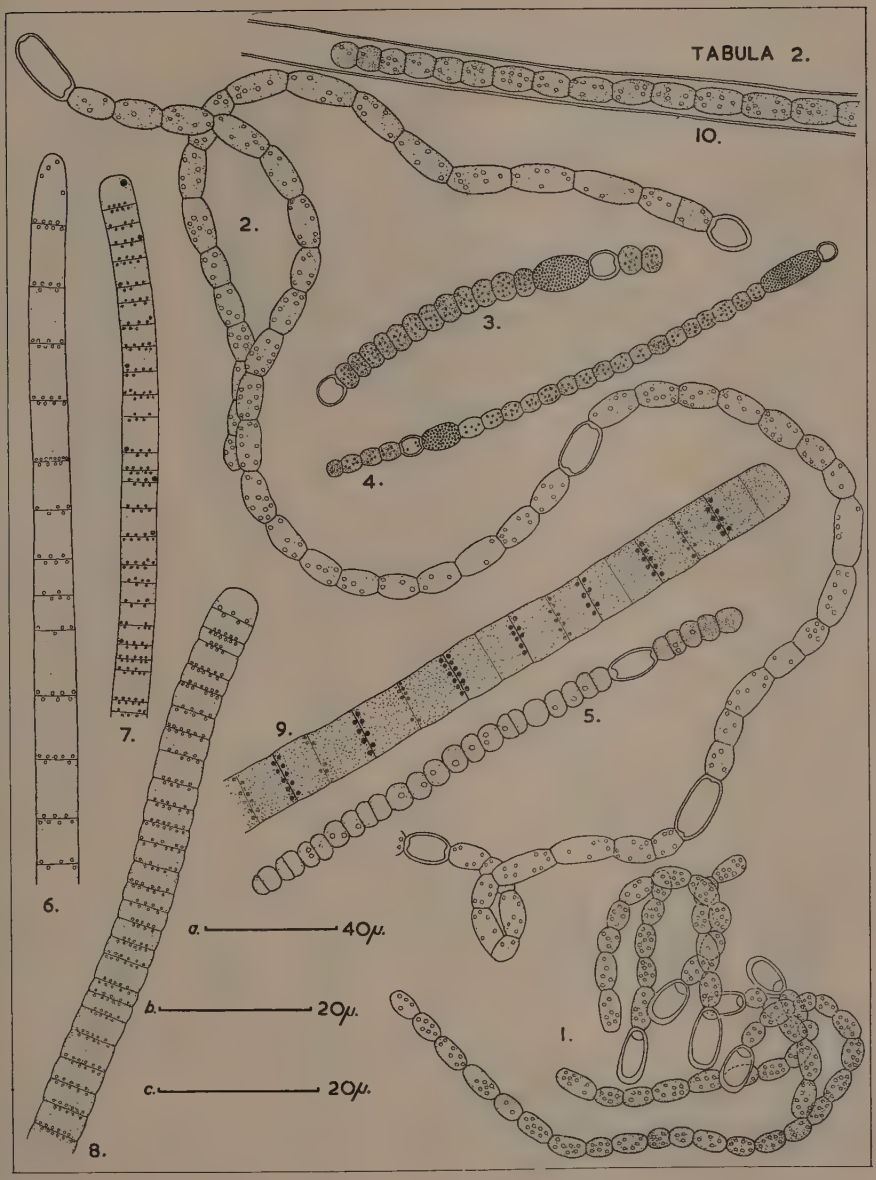
Tabula 37

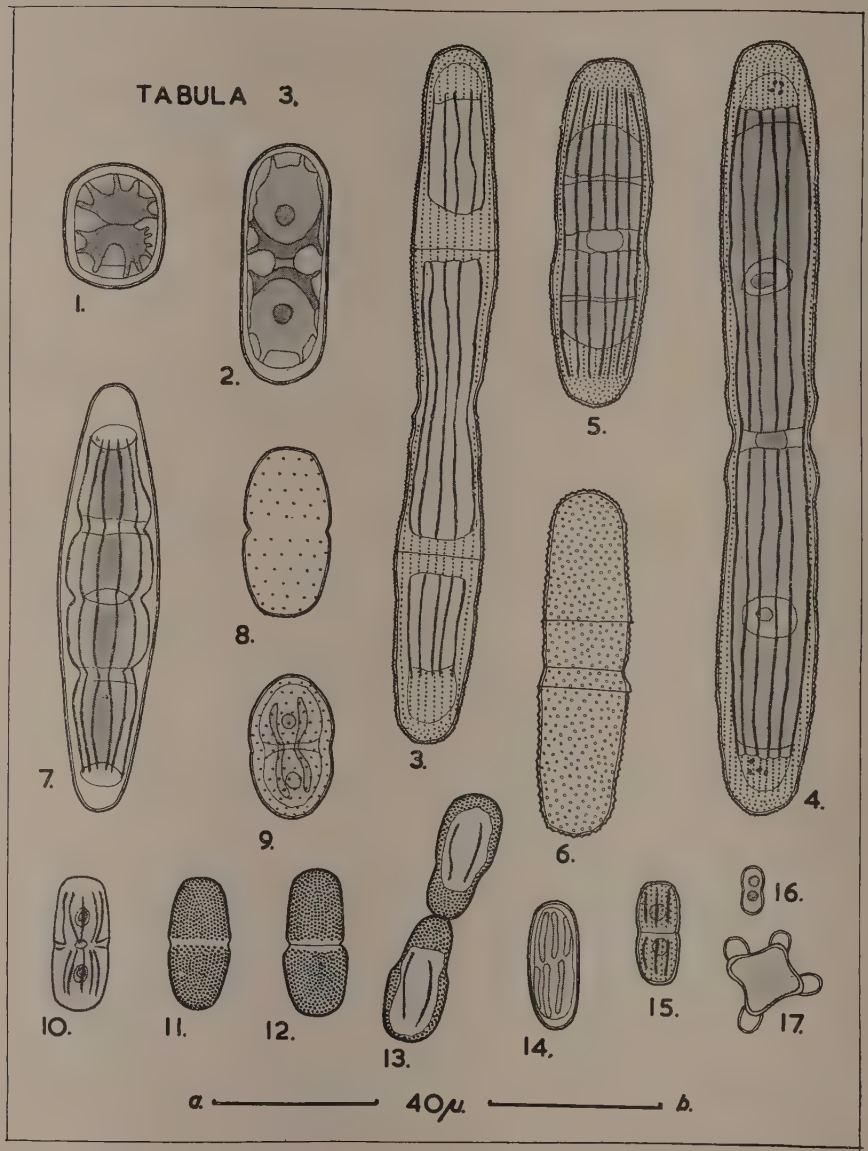
Figs.
H–K. *Micrasterias denticulata* Bréb.

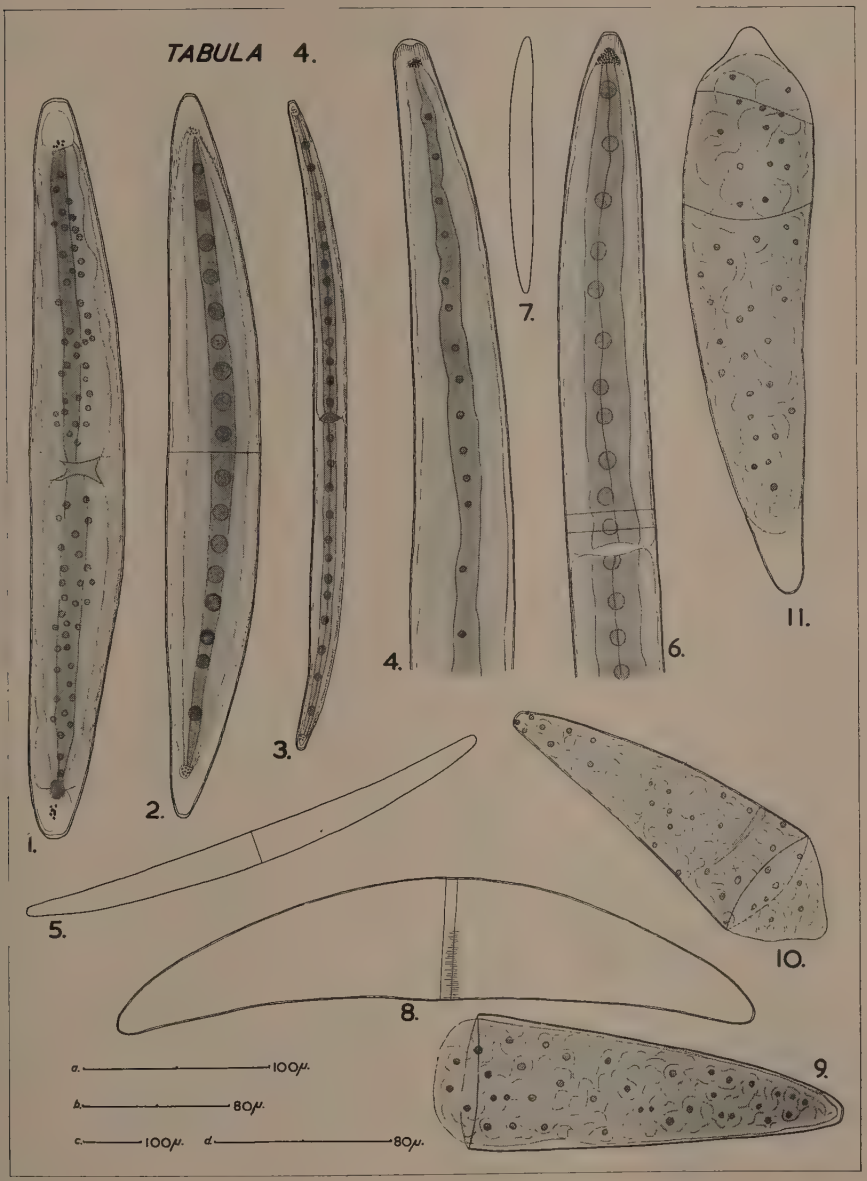
TOPOGRAPHICAL MAP.

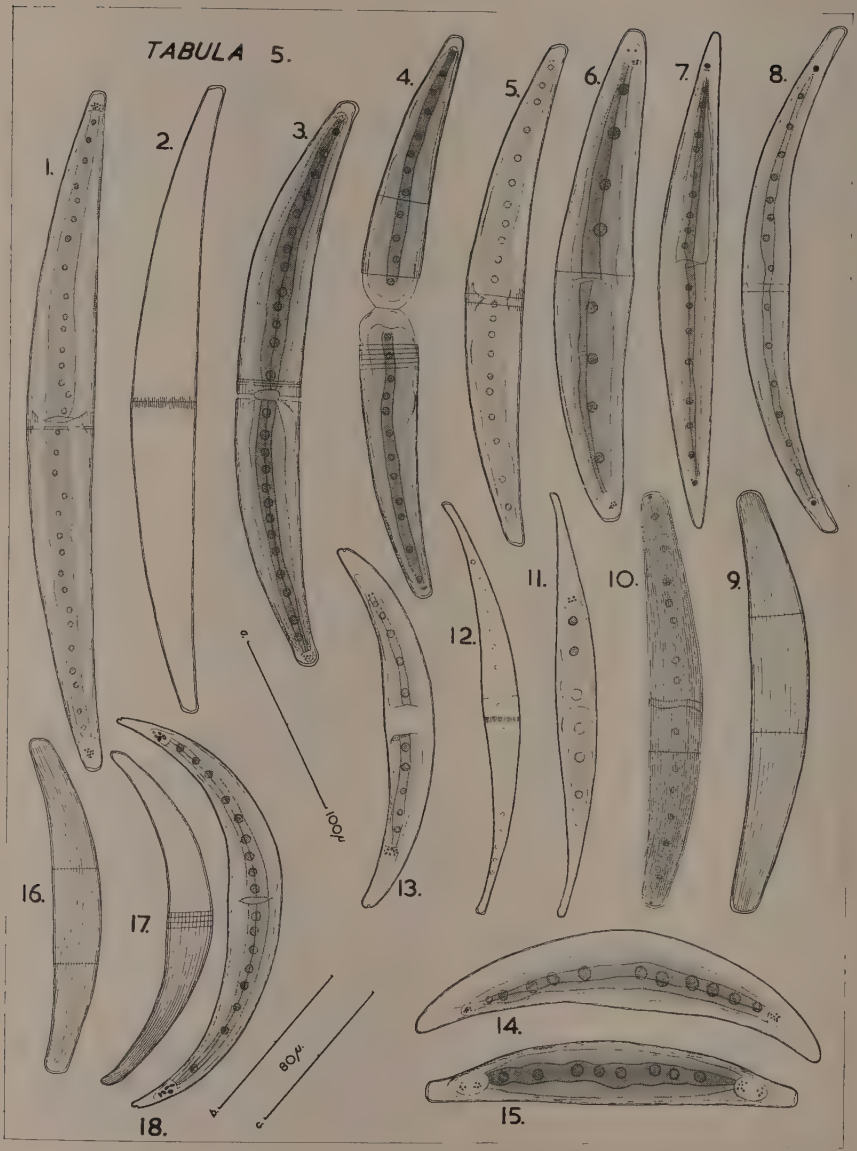



TABULA I.
4.
6.
5.
3.
7.
2.
40μ.
1.

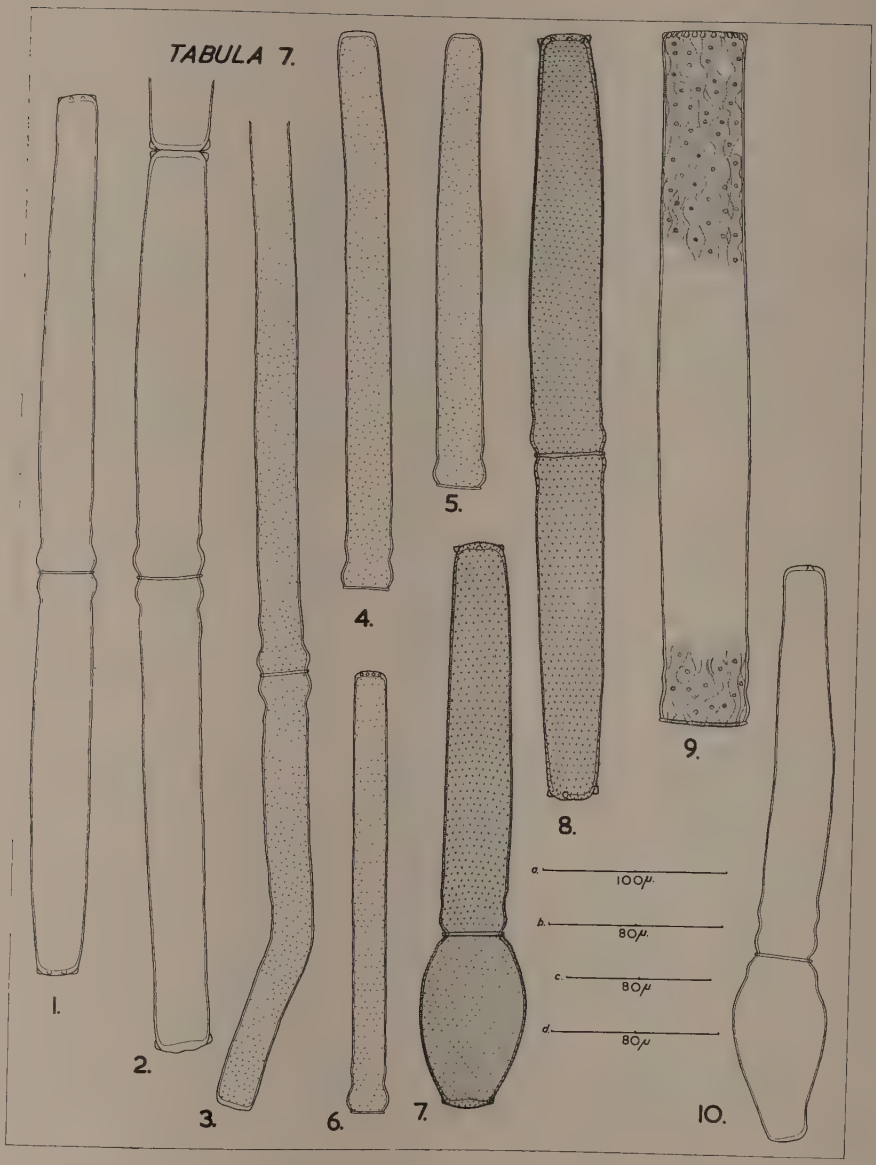

TABULA 2.
10.
2.
3.
4.
5.
6.
7.
8.
9.
1.
a. 40μ.
b. 20μ.
c. 20μ.

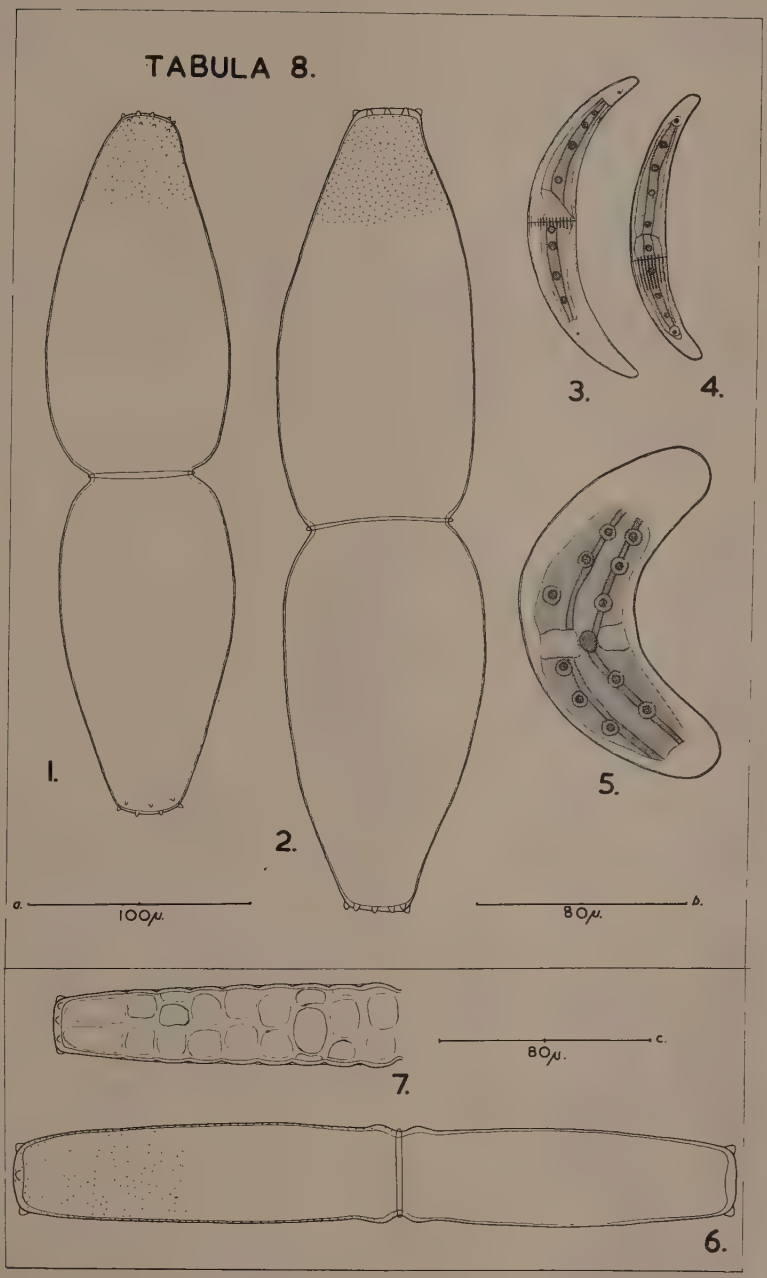

TABULA 3.
1.
2.
3.
4.
5.
6.
7.
8.
9.
10.
11.
12.
13.
14.
15.
16.
17.
a.
40μ.
b.


TABULA 4.
1.
2.
3.
4.
5.
6.
7.
8.
9.
10.
11.
a. 100μ.
b. 80μ.
c. 100μ.
d. 80μ.


TABULA 5.
1.
2.
3.
4.
5.
6.
7.
8.
9.
10.
11.
12.
13.
16.
17.
18.
14.
15.
100μ
80μ

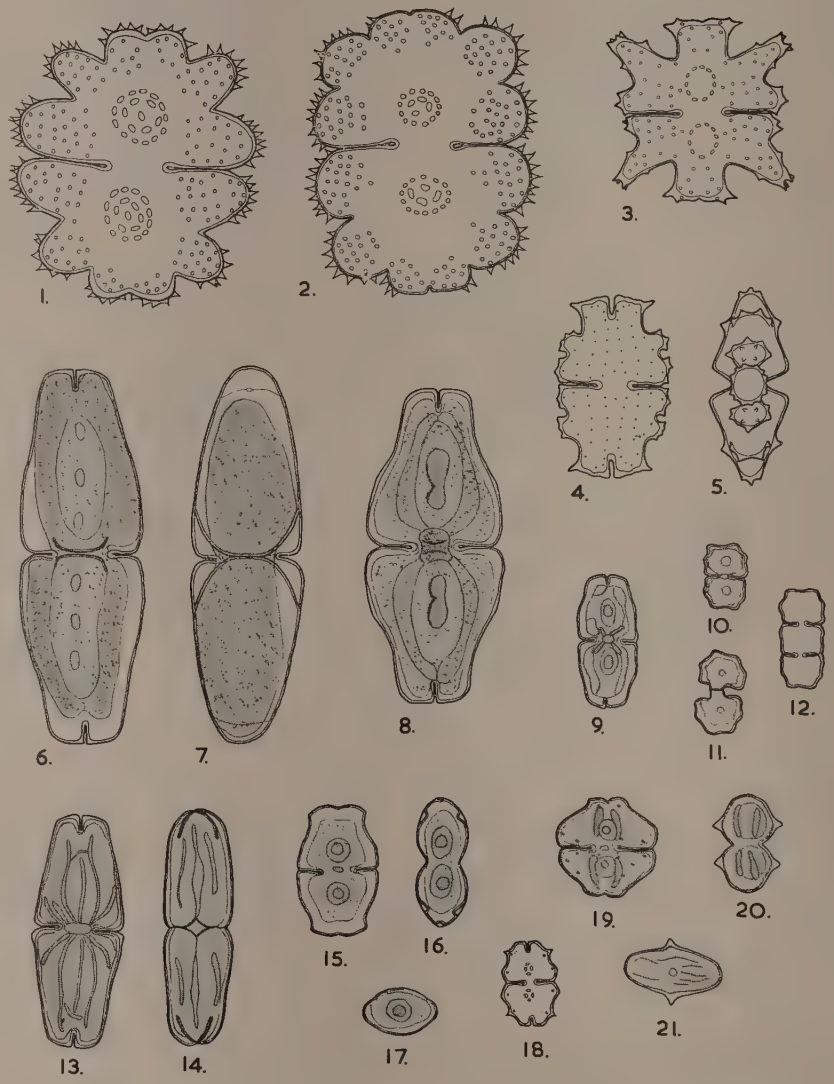
TABULA 6.
c. 80μ.
1.
2.
3.
4.
5.
6.
7.
8.
9.
10.
11.
12.
13.
14.
15.
16.
17.
18.
19.
20.
21.
22.
23.
24.
a. 40μ b.

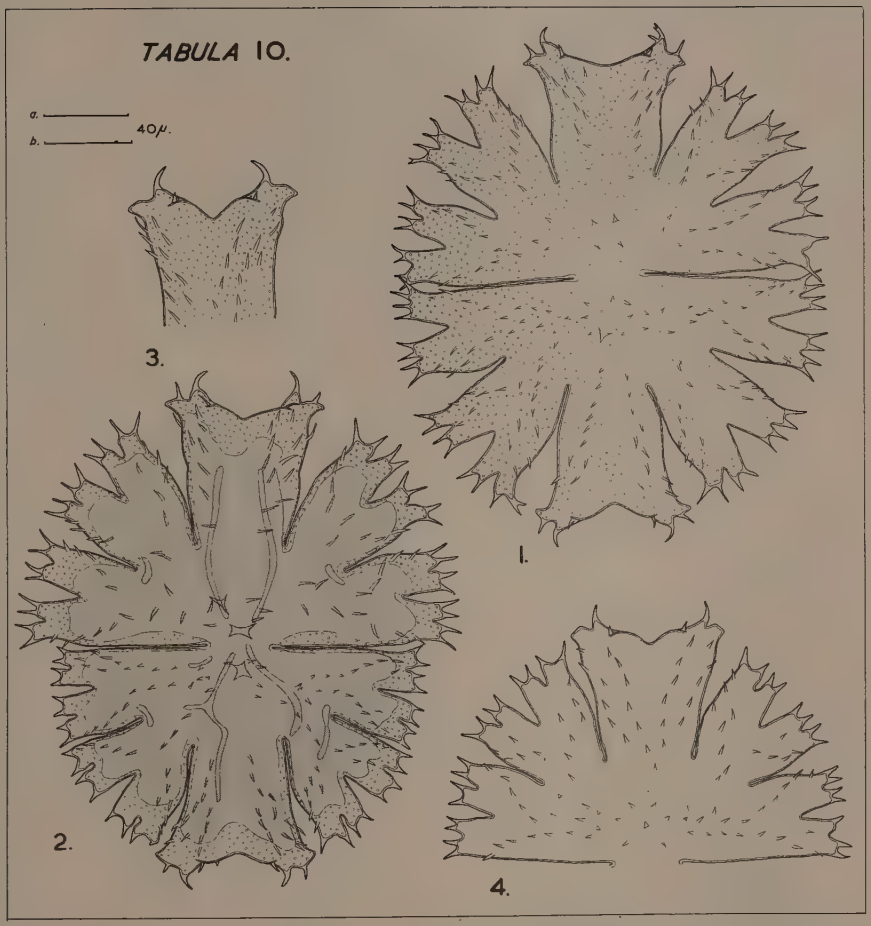

TABULA 7.
1.
2.
3.
4.
5.
6.
7.
8.
9.
10.
a. 100μ.
b. 80μ.
c. 80μ
d. 80μ

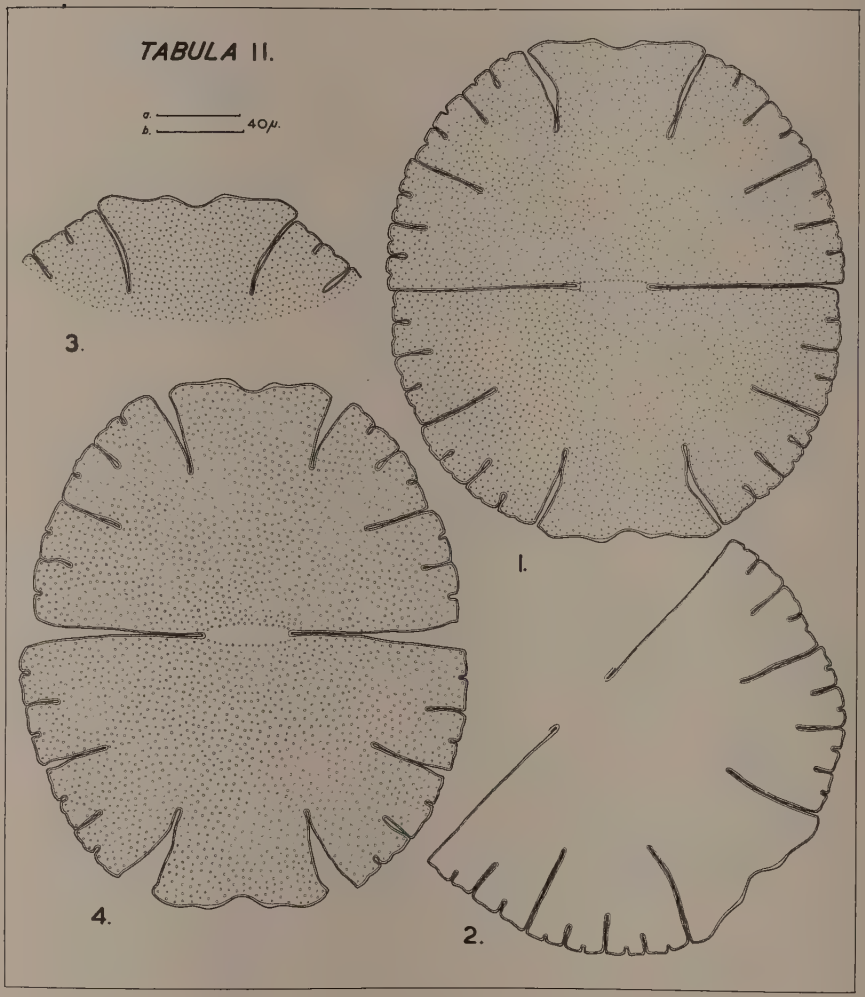

TABULA 8.
1.
2.
3.
4.
5.
a.
100μ.
80μ.
b.
7.
80μ.
c.
6.

a. —— 40μ. —— b.

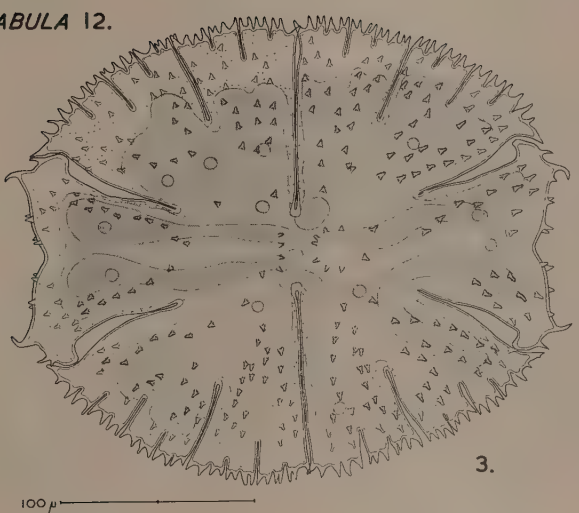
TABULA 9.

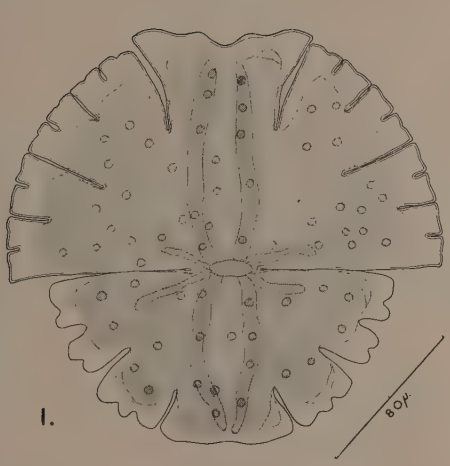


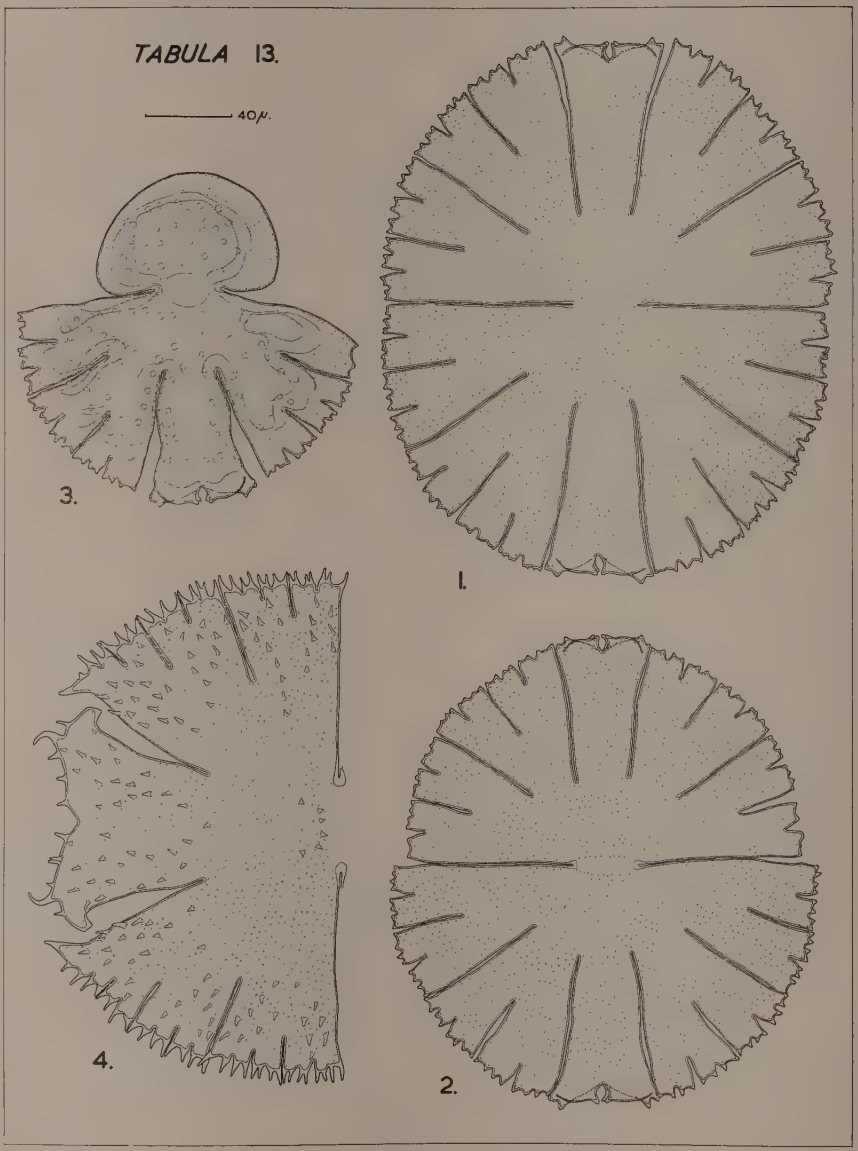

TABULA 10.
a.
b.
40μ.
1.
2.
3.
4.

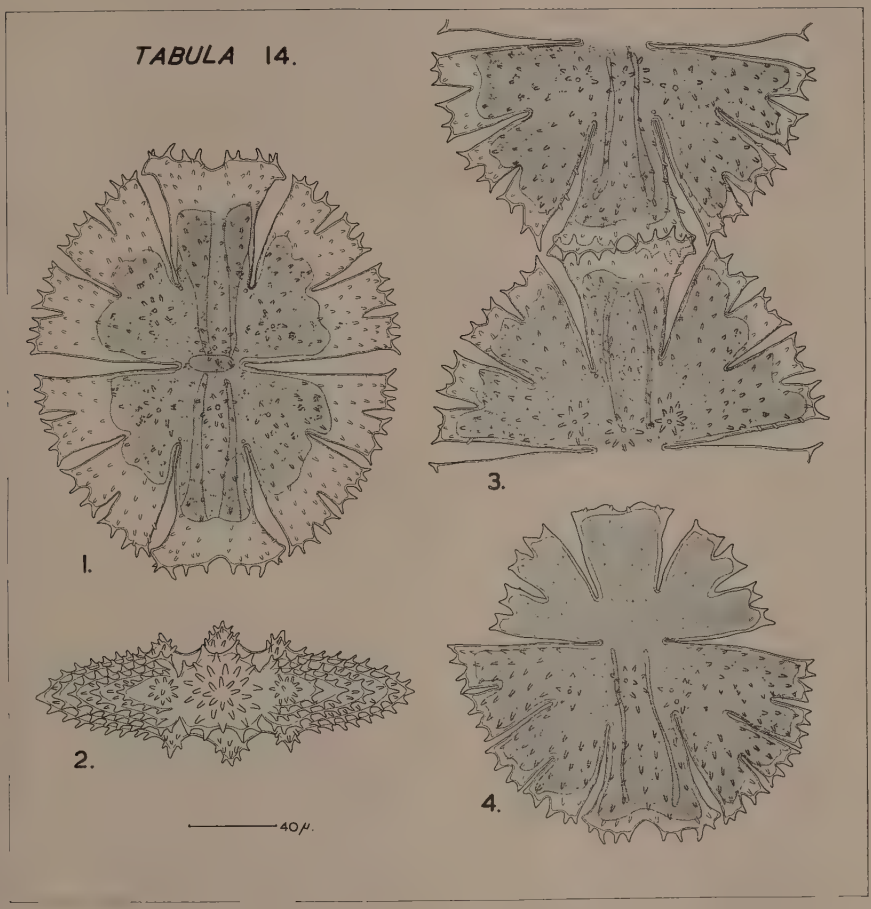

TABULA II.
a.
b.
40μ.
3.
1.
4.
2.

TABULA 12.

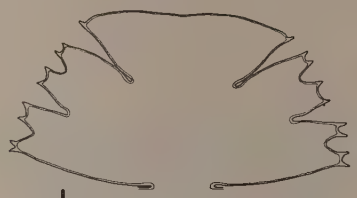




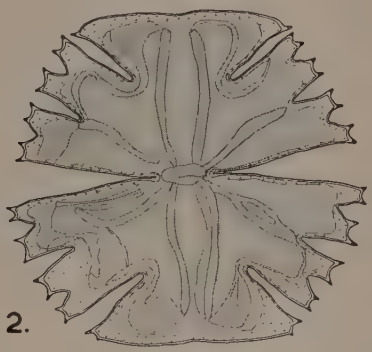

TABULA 13.
40μ.
3.
1.
4.
2.


TABULA 14.
1.
2.
3.
4.
40μ.

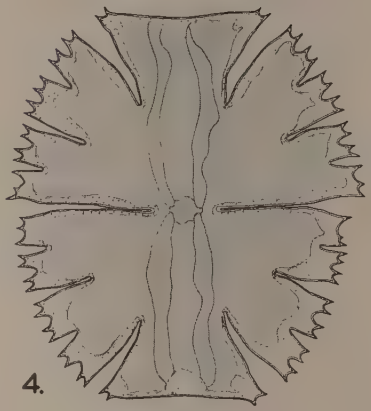
TABULA 15.



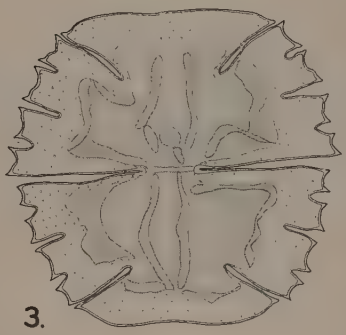
1.



2.

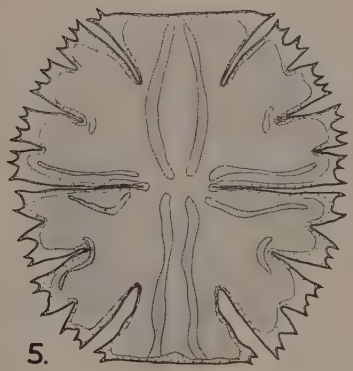


4.



3.

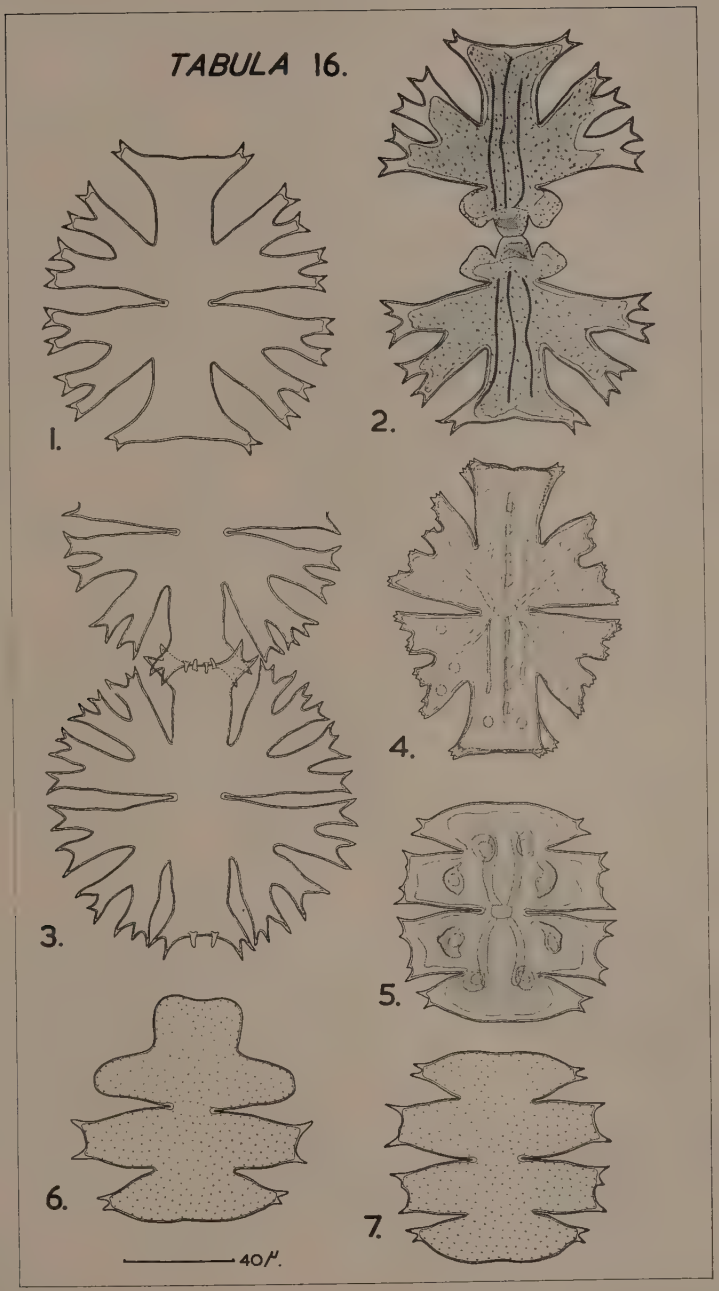
6.



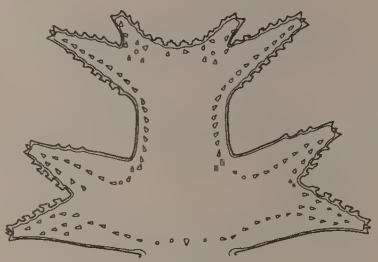
5.

II ——— 40μ

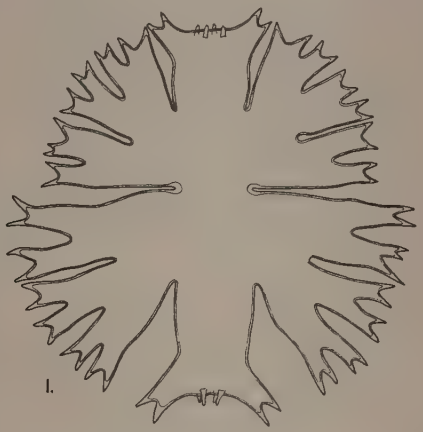
b ——— 40μ


TABULA 16.
1.
2.
3.
4.
5.
6.
7.
40 μ.

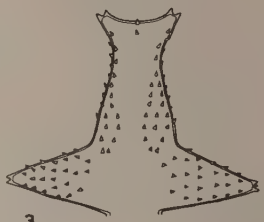
TABULA 17.



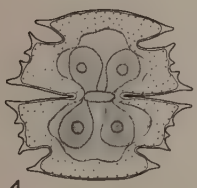
2.



1.

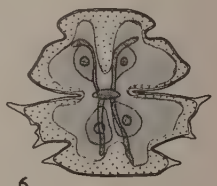


3.

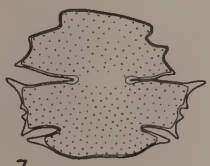


4.

5.



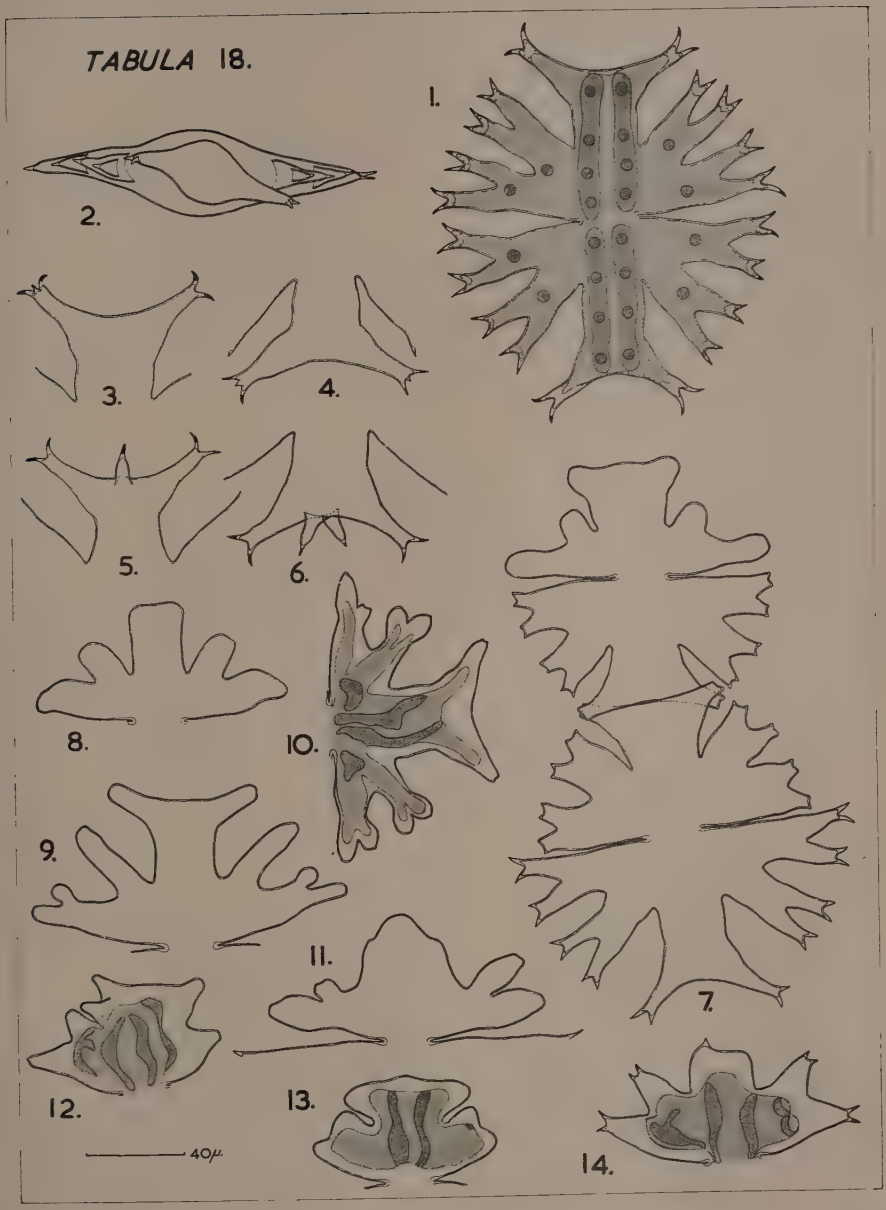
6.

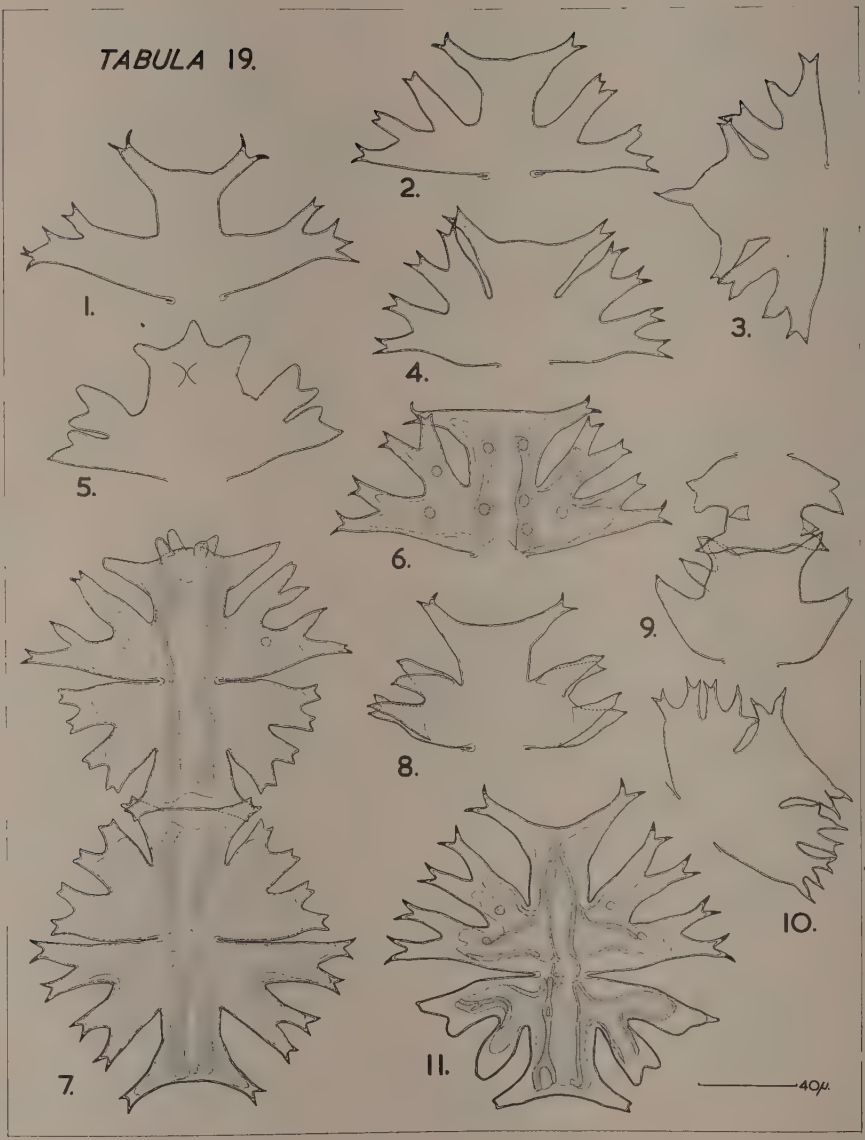


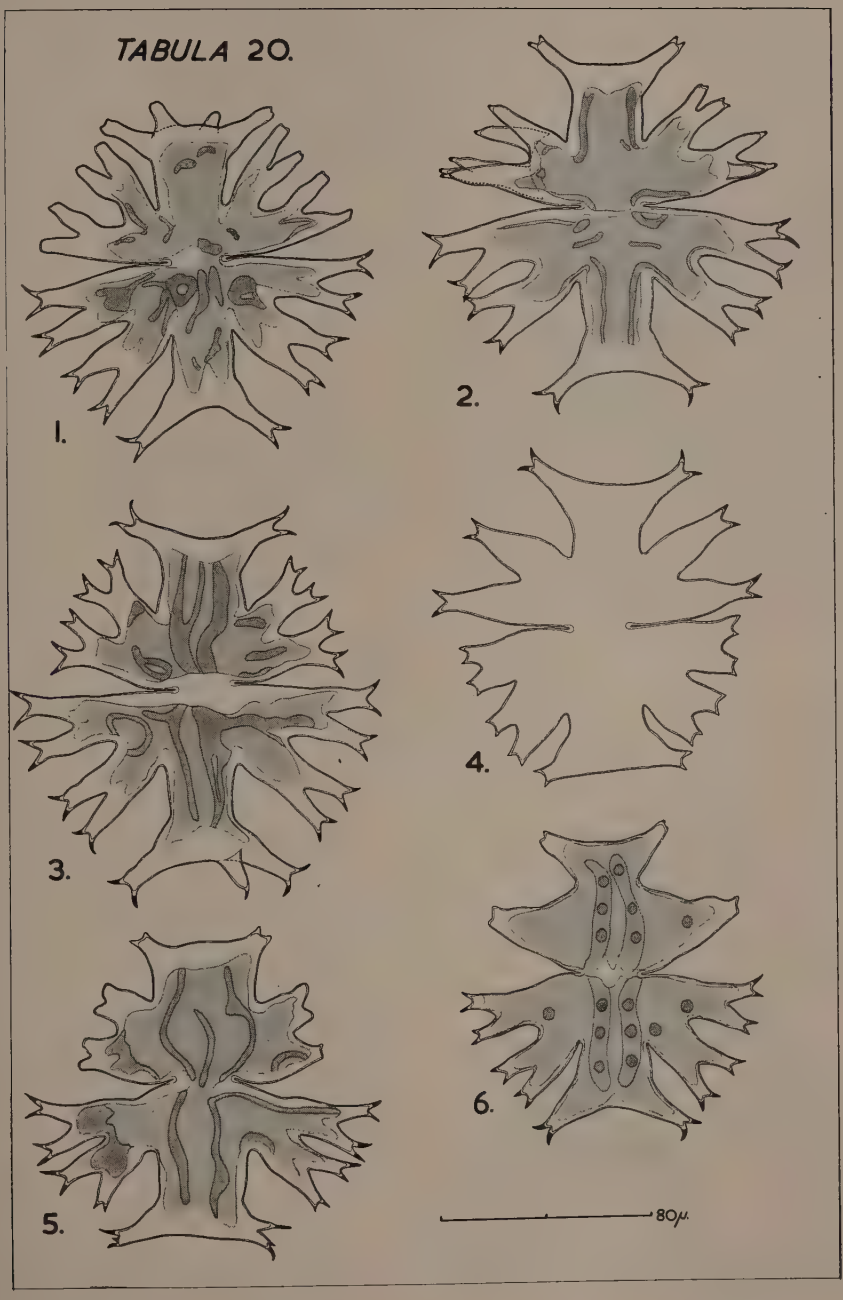
7.

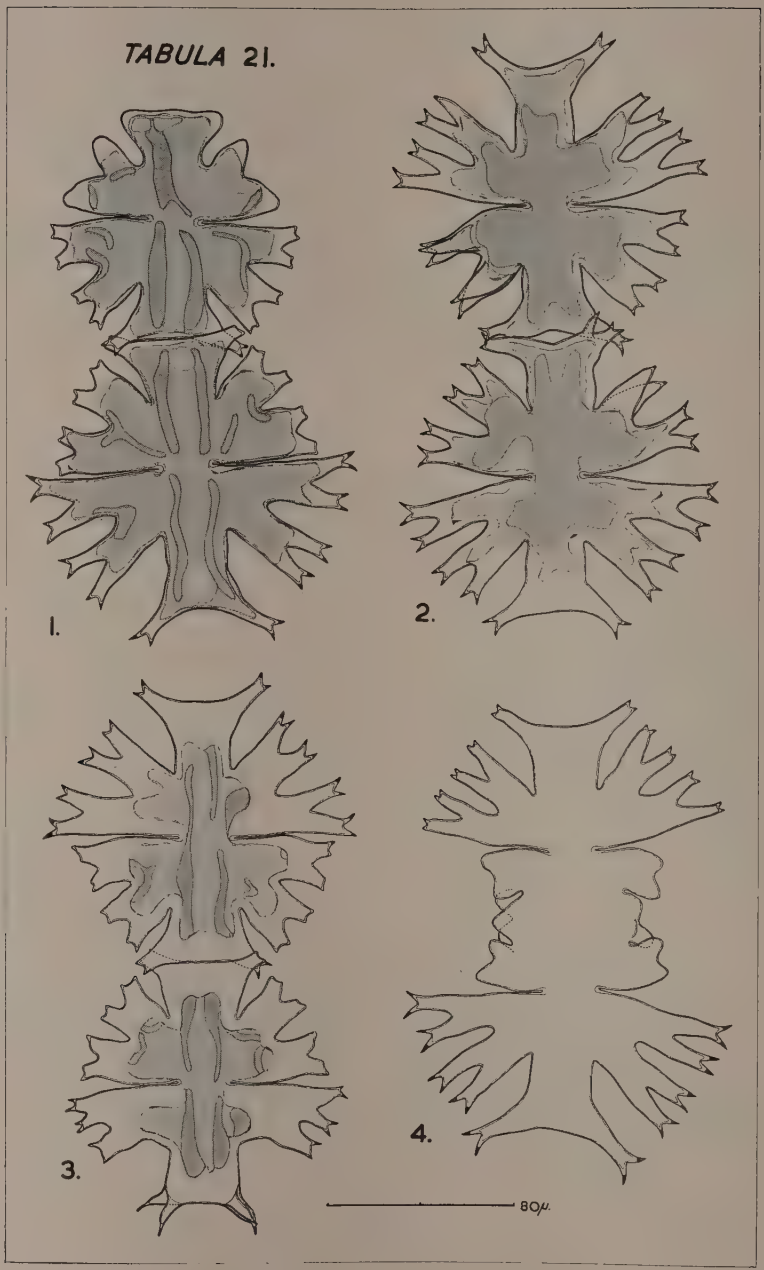
8.

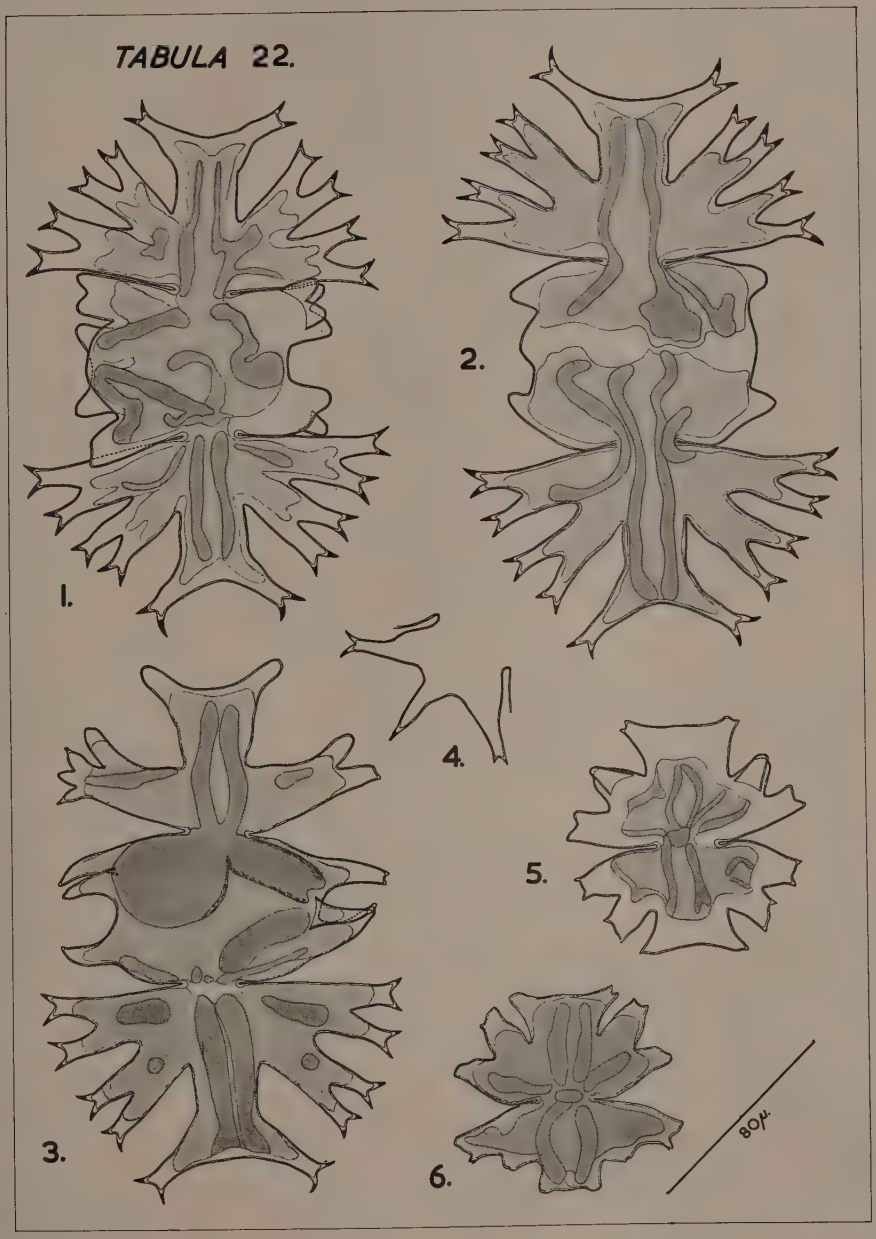
80μ.

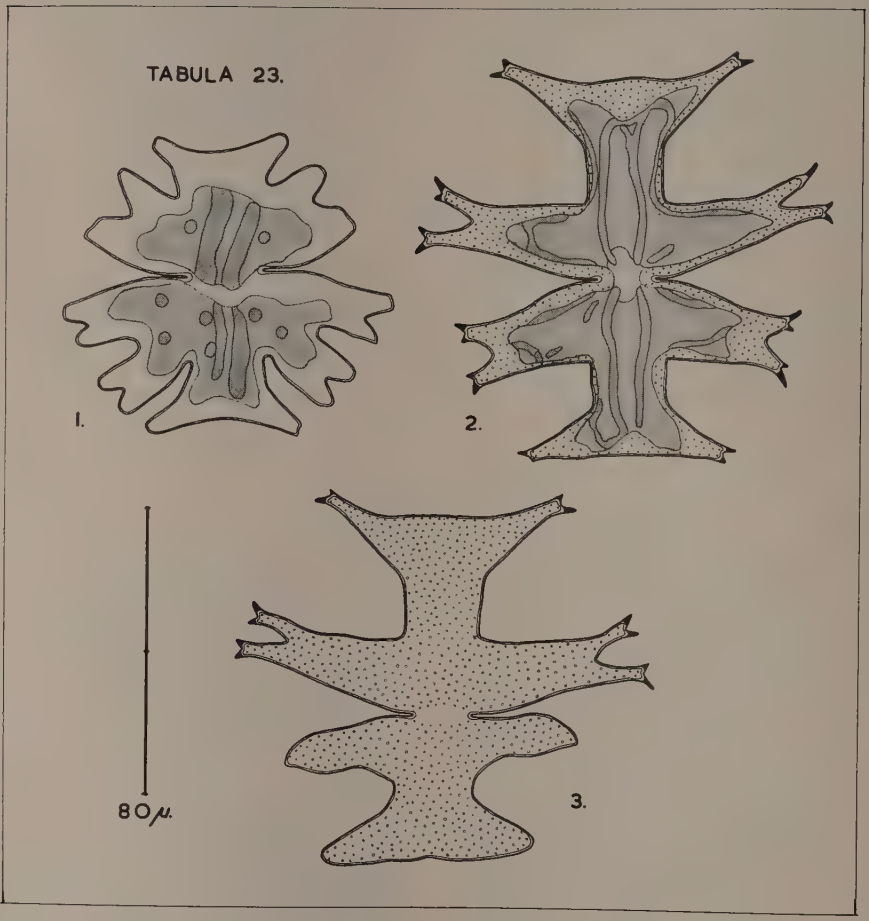

TABULA 18.
1.
2.
3.
4.
5.
6.
7.
8.
9.
10.
11.
12.
13.
14.
40μ

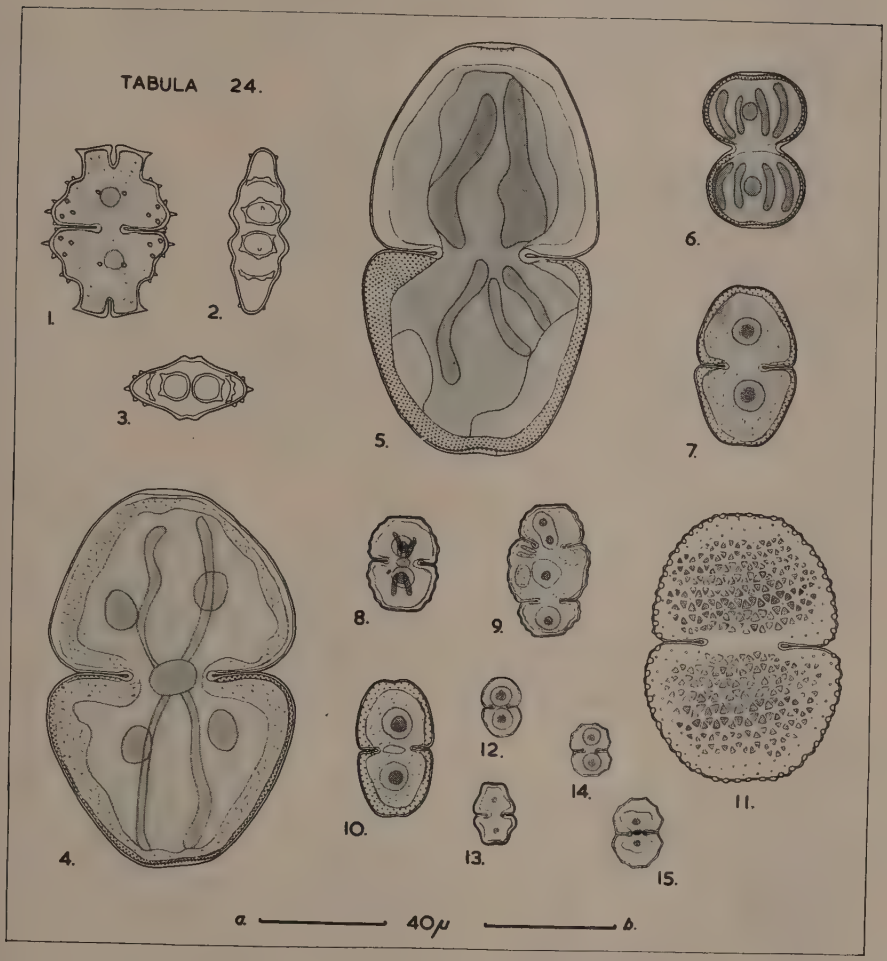

TABULA 19.
1.
2.
3.
4.
5.
6.
7.
8.
9.
10.
11.
40μ

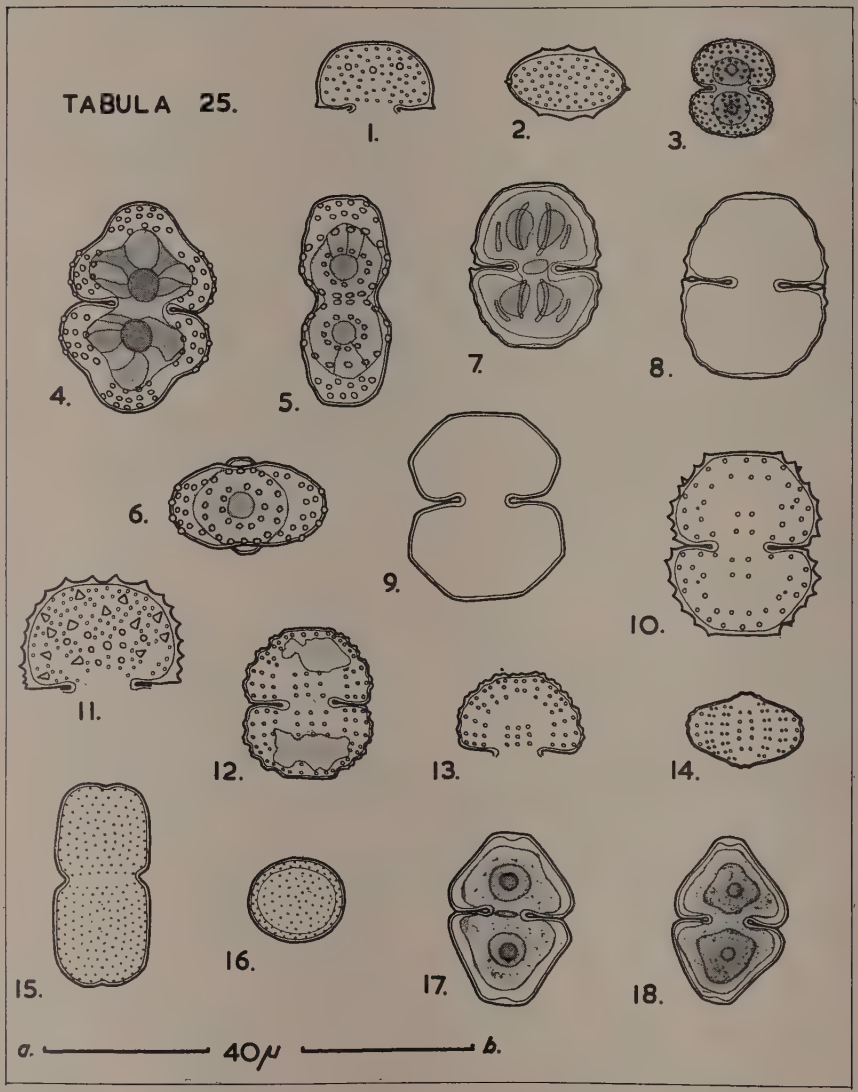

TABULA 20.
1.
2.
3.
4.
5.
6.
80μ.

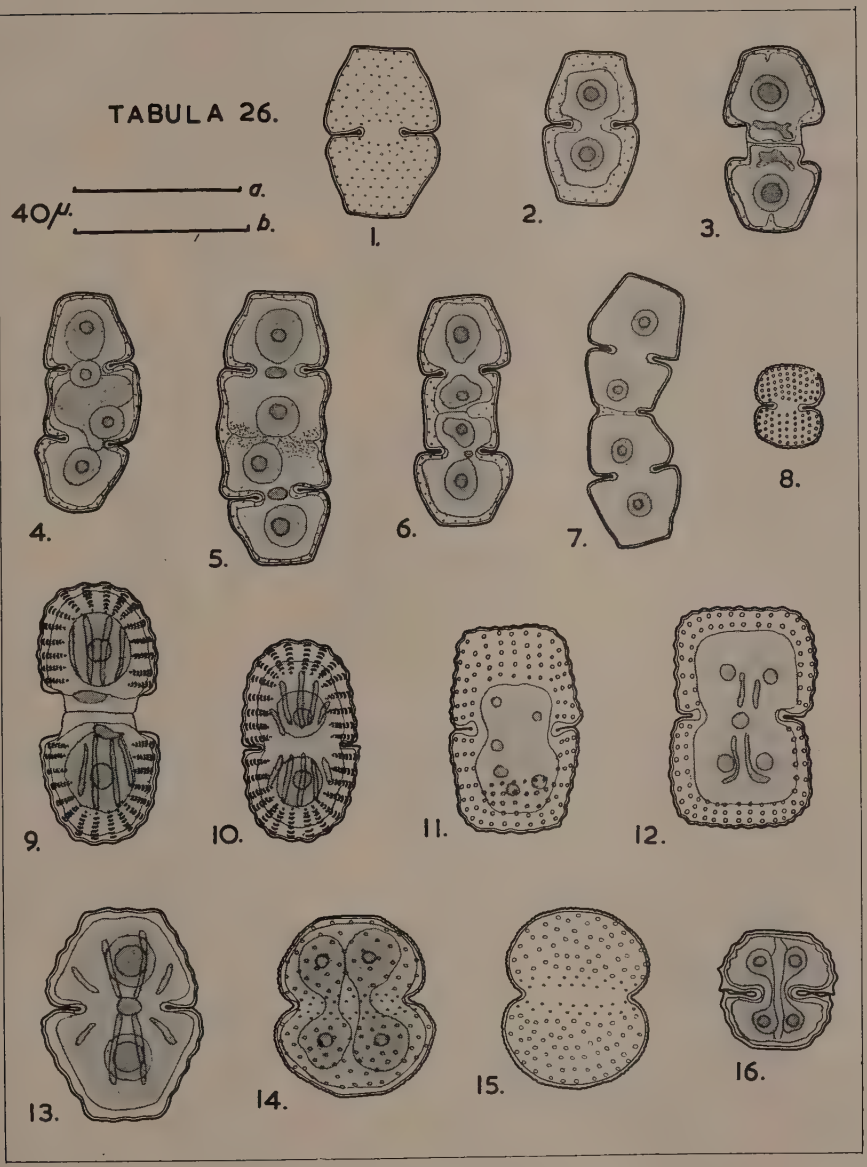

TABULA 21.
1.
2.
3.
4.
80μ.

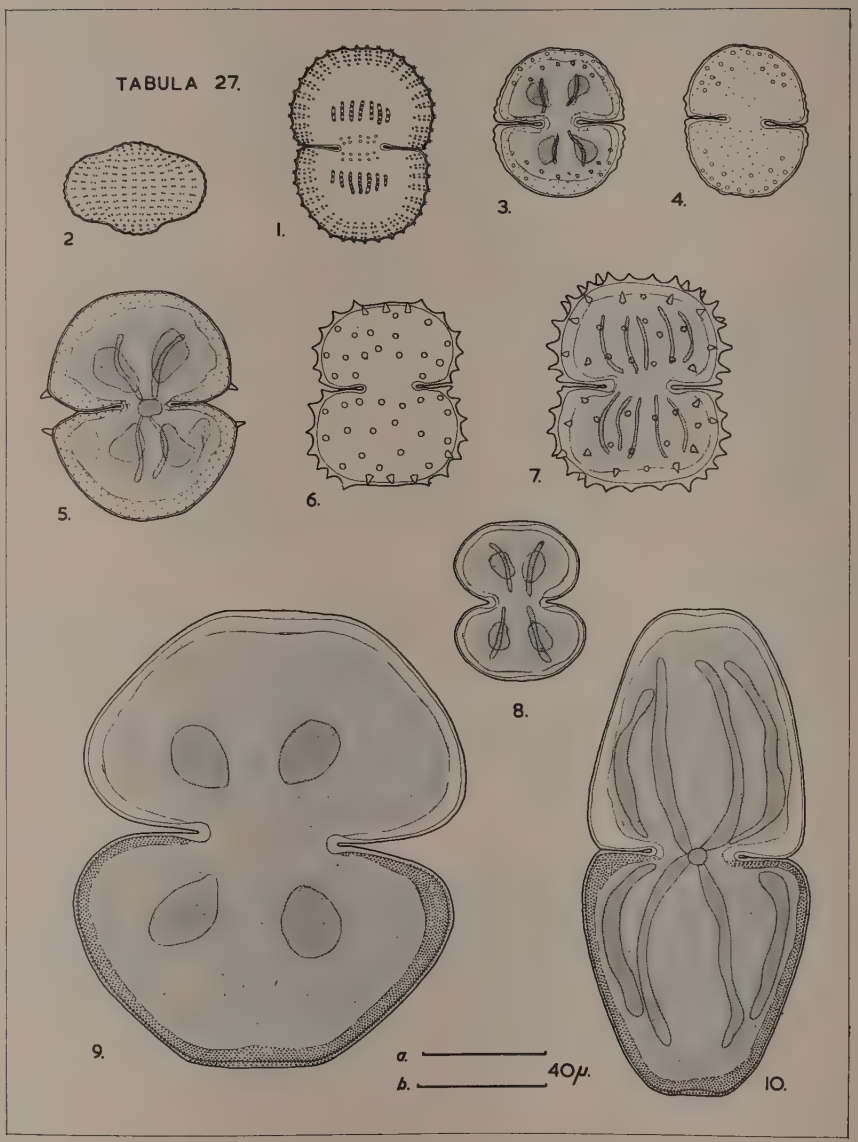

TABULA 22.
1.
2.
3.
4.
5.
6.
80μ

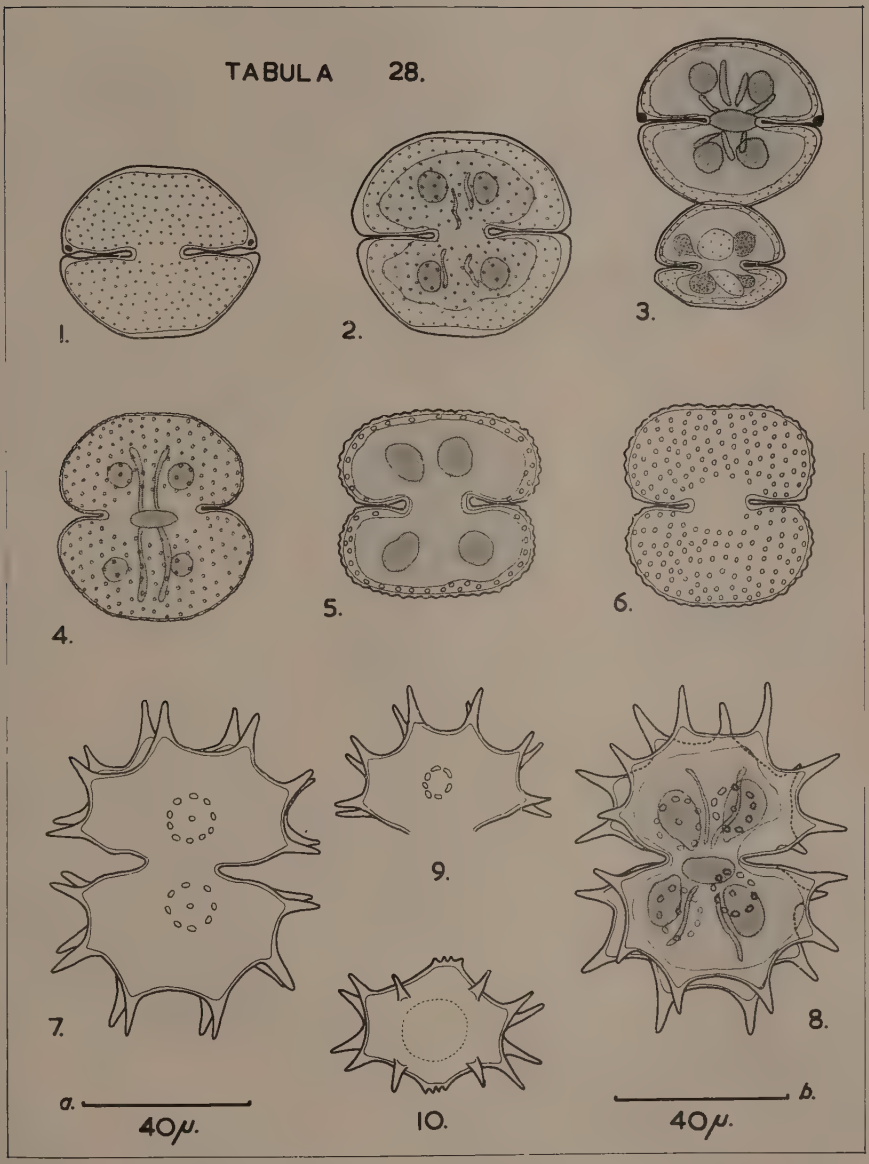

TABULA 23.
1.
2.
3.
80 μ.

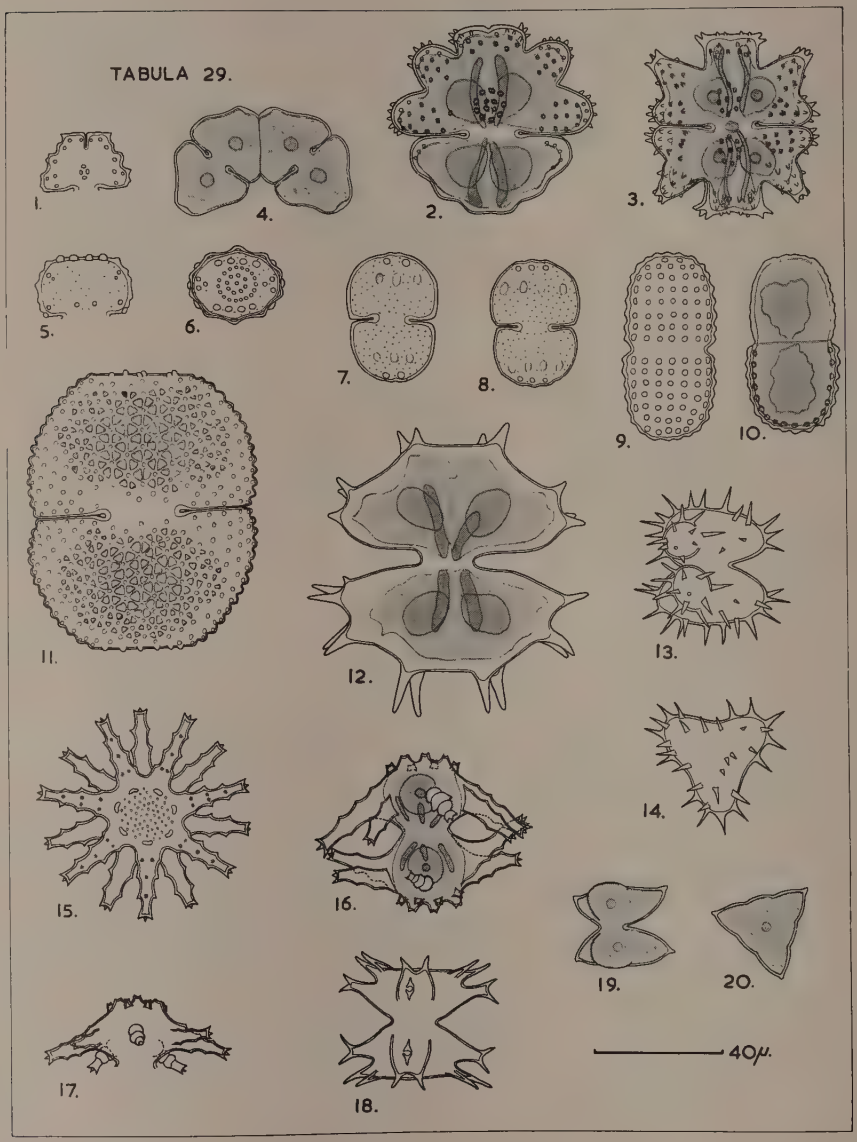

TABULA 24.
1.
2.
3.
4.
5.
6.
7.
8.
9.
10.
11.
12.
13.
14.
15.
a
40μ
b.

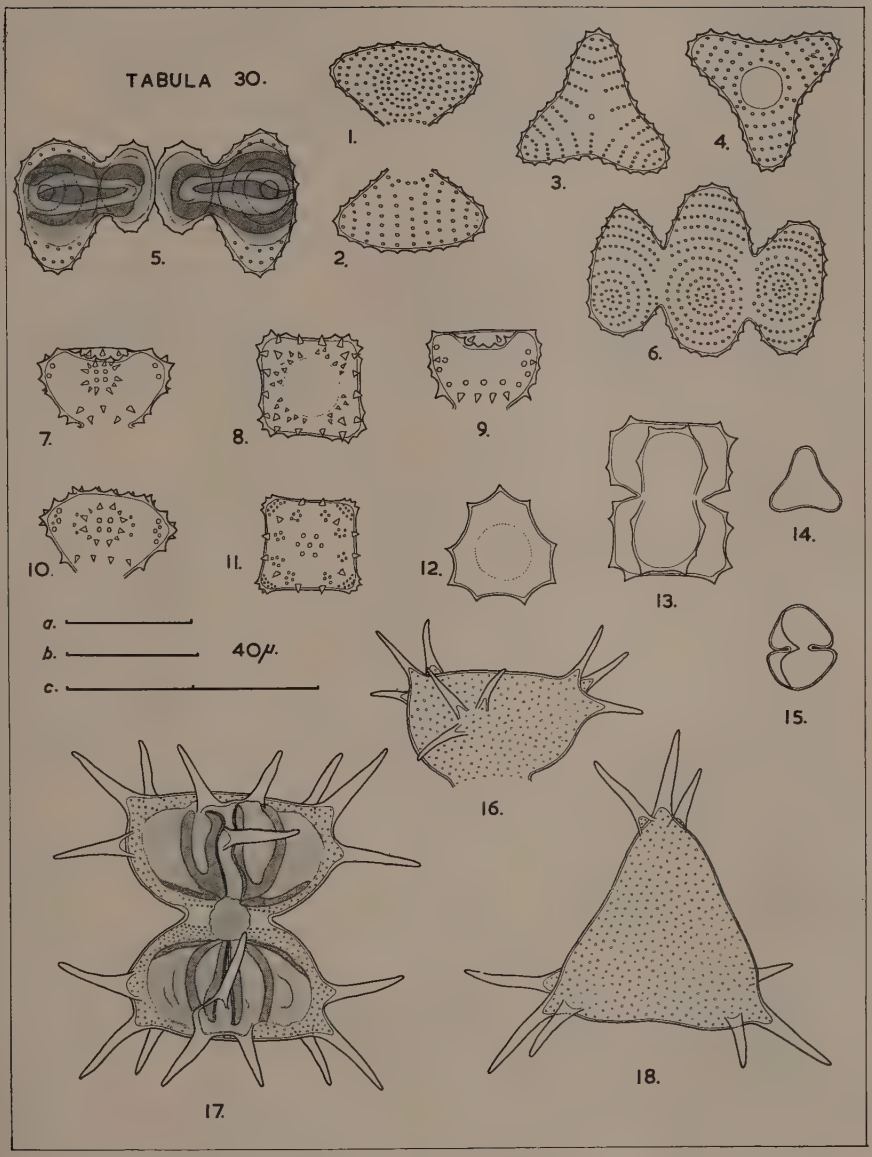

TABULA 25.
1.
2.
3.
4.
5.
7.
8.
6.
9.
10.
11.
12.
13.
14.
15.
16.
17.
18.
a.
40μ
b.

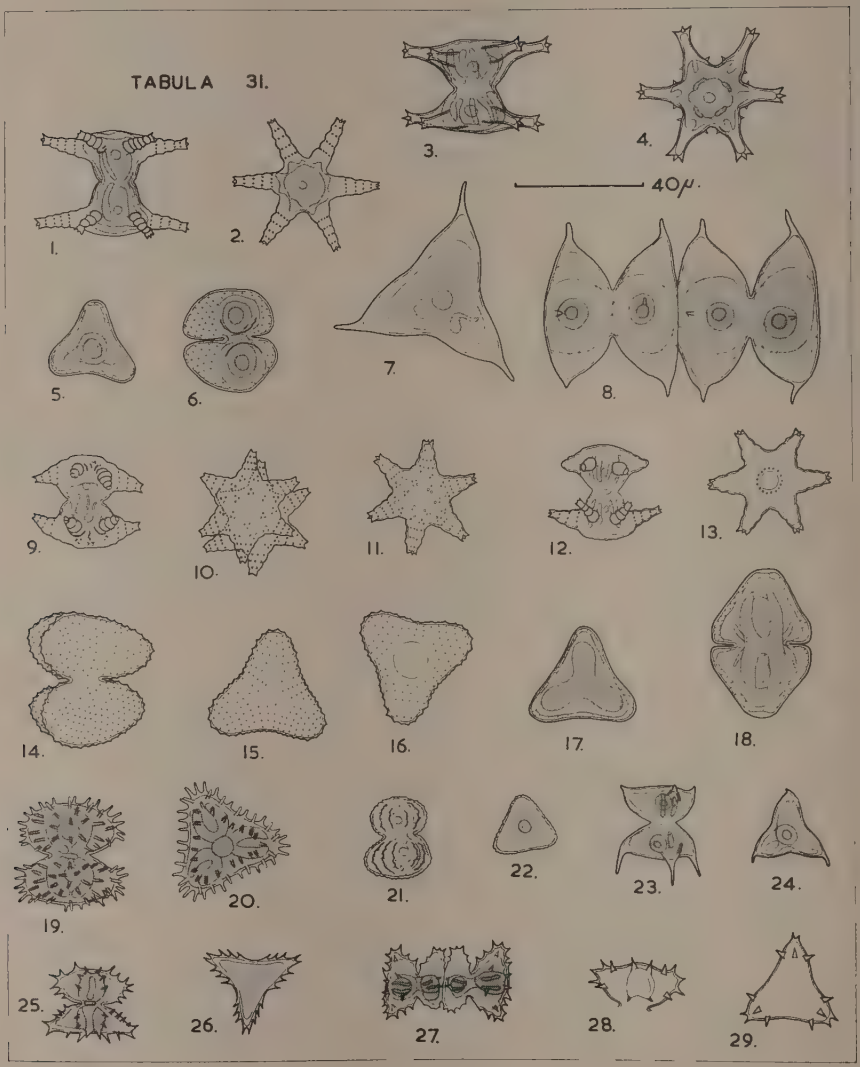

TABULA 26.
40μ.
a.
b.
1.
2.
3.
4.
5.
6.
7.
8.
9.
10.
11.
12.
13.
14.
15.
16.

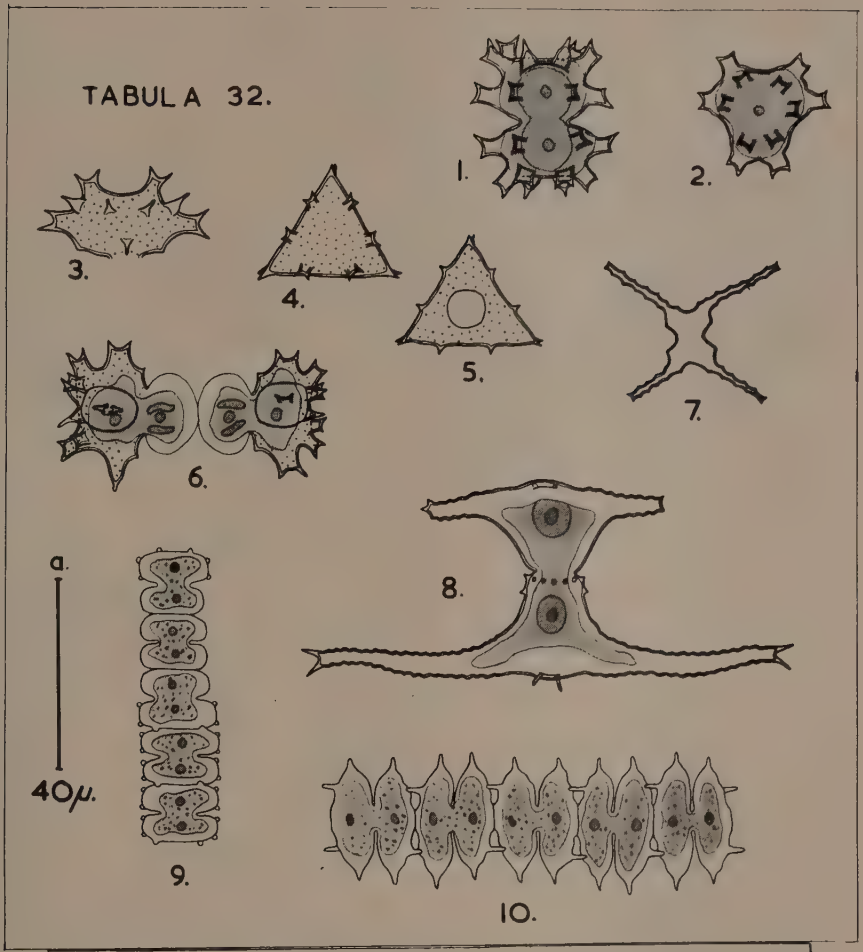

TABULA 27.
1.
2
3.
4.
5.
6.
7.
8.
9.
10.
a.
b.
40μ.

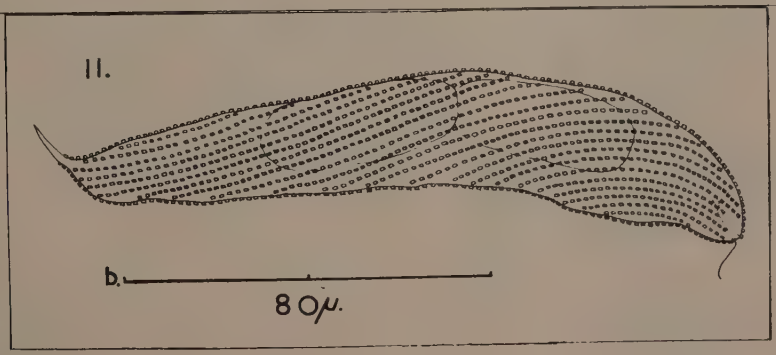

TABULA 28.
1.
2.
3.
4.
5.
6.
7.
9.
8.
a.
40μ.
10.
40μ.
b.


TABULA 29.
1.
4.
2.
3.
5.
6.
7.
8.
9.
10.
11.
12.
13.
14.
15.
16.
17.
18.
19.
20.
40μ.

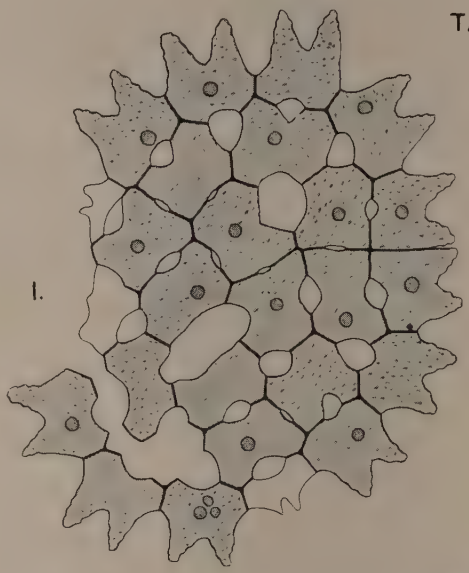

TABULA 30.
1.
2.
3.
4.
5.
6.
7.
8.
9.
10.
11.
12.
13.
14.
15.
16.
17.
18.
a.
b.
c.
40μ.


TABULA 31.
40μ.
1.
2.
3.
4.
5.
6.
7.
8.
9.
10.
11.
12.
13.
14.
15.
16.
17.
18.
19.
20.
21.
22.
23.
24.
25.
26.
27.
28.
29.

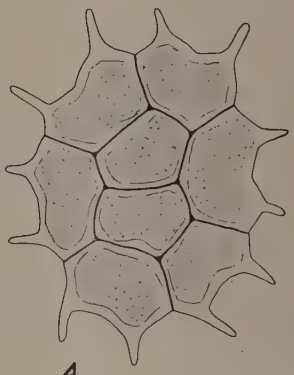

TABULA 32.
1.
2.
3.
4.
5.
6.
7.
8.
a.
40μ.
9.
10.


11.
b.
80μ.

TABULA 33.



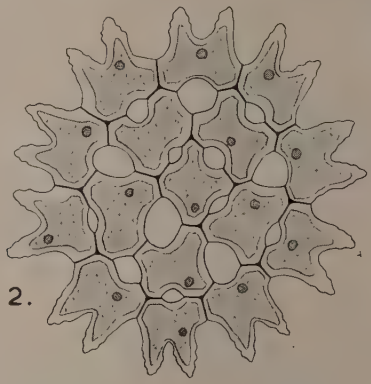
1.



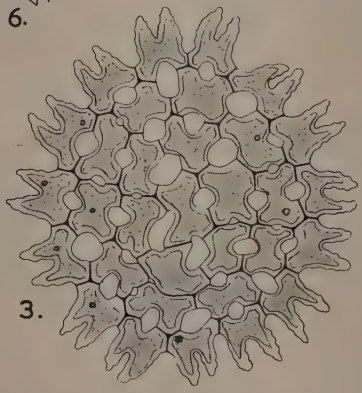
4.

5.

6.



2.

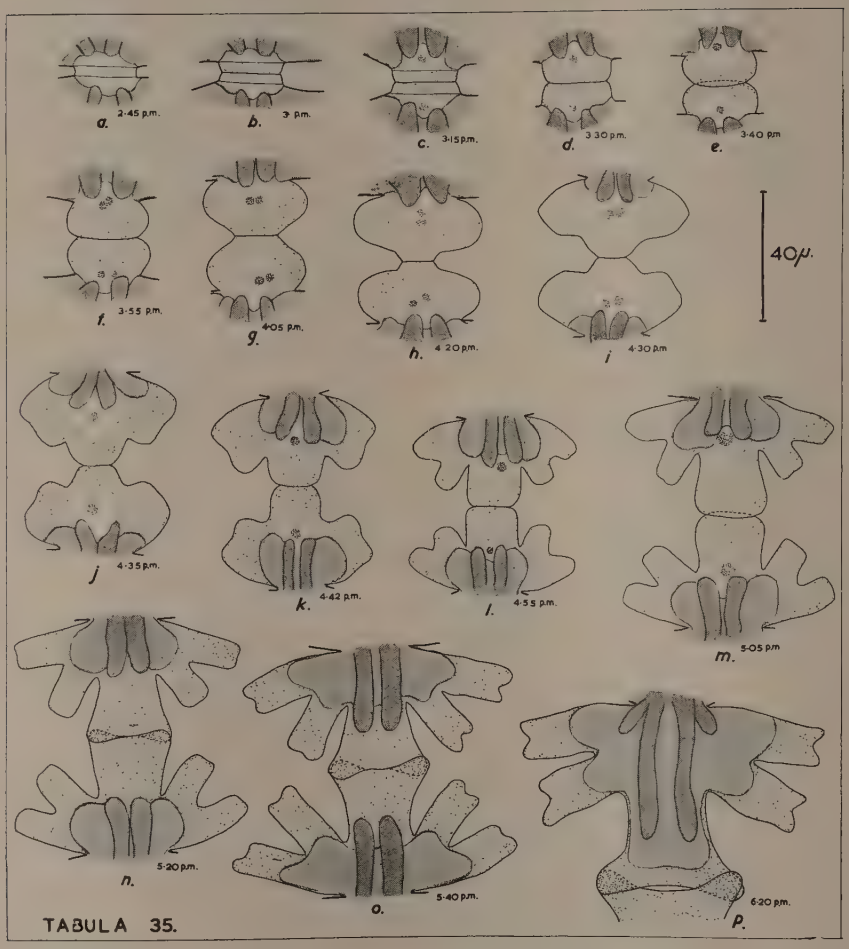


3.

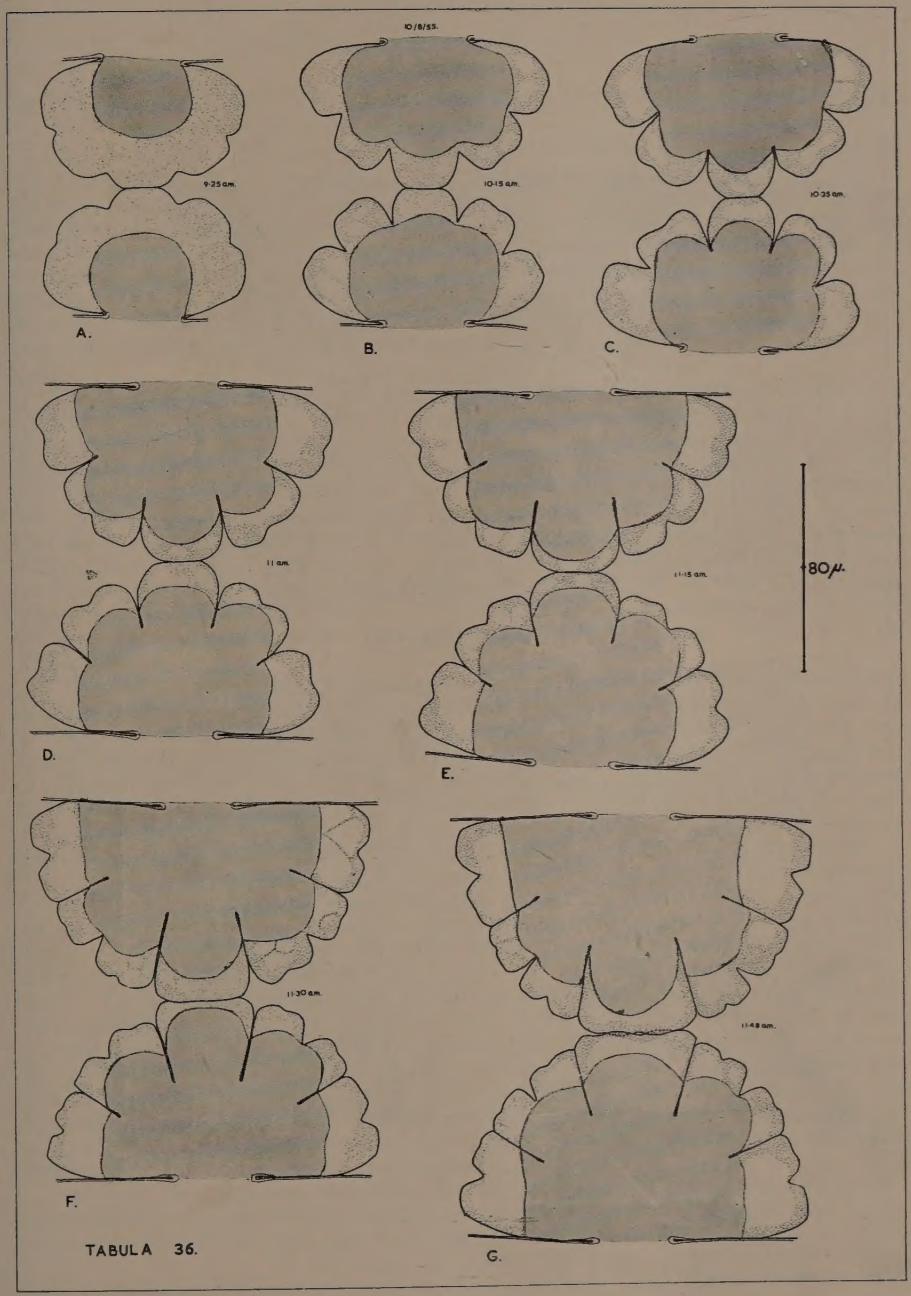
a. ——— 40μ.

b. ——— 20μ.

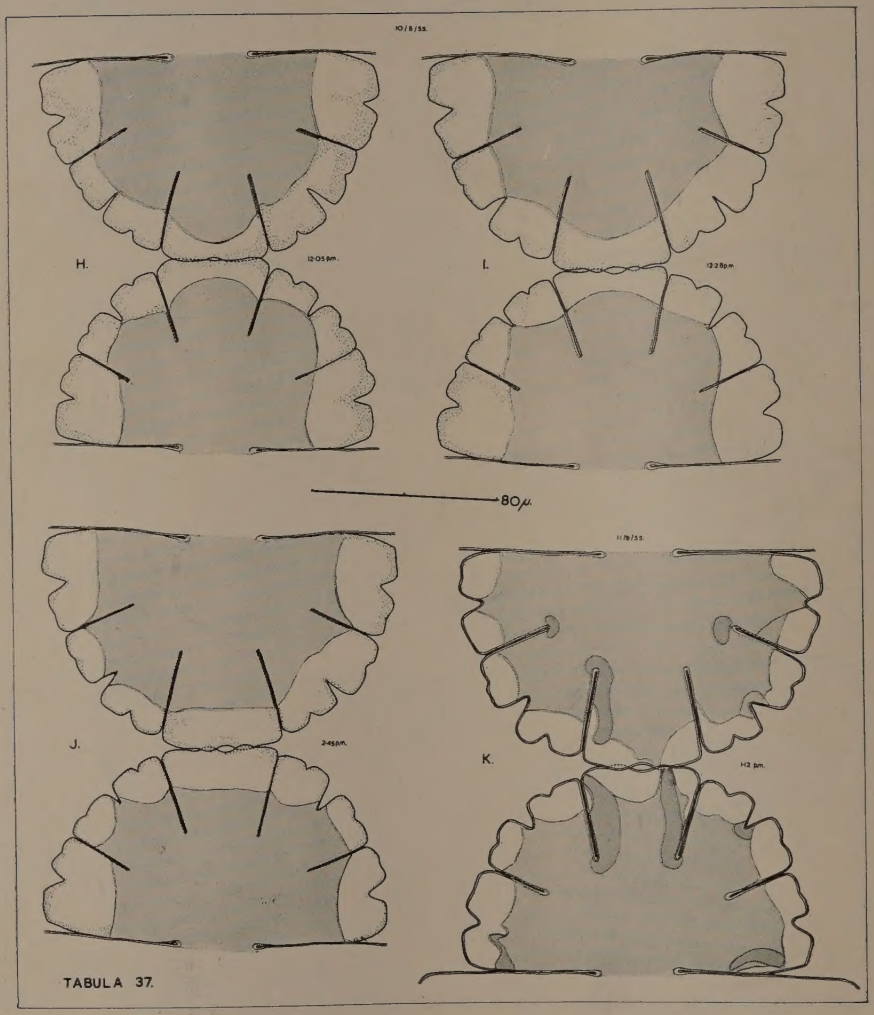
TABULA 34.


a. 2·45 p.m.
b. 3 p.m.
c. 3·15 p.m.
d. 3·30 p.m.
e. 3·40 p.m.
40μ.
f. 3·55 p.m.
g. 4·05 p.m.
h. 4·20 p.m.
i. 4·30 p.m.
j. 4·35 p.m.
k. 4·42 p.m.
l. 4·55 p.m.
m. 5·05 p.m.
n. 5·20 p.m.
o. 5·40 p.m.
p. 6·20 p.m.

TABULA 35.


10/8/55.
9·25 a.m.
A.
10·15 a.m.
B.
10·35 a.m.
C.
11 a.m.
D.
11·15 a.m.
E.
80μ.
11·30 a.m.
F.
11·48 a.m.
G.

TABULA 36.



TABULA 37.

Review

Flora Zambesiaca, Volume 1, Part 1, published by the Crown Agents, London; 366 pp. including illustrations. Price 25s.

The title *Flora Zambesiaca* is an appropriate one for an international project of this kind dealing, as it does, with the flowering plants of territories linked by one of Africa's greatest rivers. The project is sponsored by the governments of Britain, Portugal and the Federation and deals with the territories of the Federation of Rhodesia and Nyasaland, Mocambique and the Bechuanaland Protectorate. The *Flora* is produced by an editorial committee consisting of Dr. H. Wild of the Federal Herbarium, Salisbury, Mr. A. W. Exell of the British Museum (Natural History), Mr. J. P. M. Brenan of Kew and Dr. F. A. Mendonca of Portugal. The whole production is of a very high standard with an attractive format which could well serve as a model of its kind.

Included in this first part is a brief history of botanical exploration in the area, a selected bibliography, a glossary of botanical terms, a key to plant families, a map of the area and 58 excellent line drawings illustrating most of the genera described. The arrangement follows the Bentham and Hooker system and the families now dealt with extend from the Cycadaceae to the Polygalaceae, covering some 90 genera and 306 species. The text results from the collaboration of the following authors: G. Cufodontis (Pittosporaceae), A. W. Exell (Papaveraceae, Fumariaceae, Cruciferae, Polygalaceae), A. W. Exell and E. Milne-Redhead (Ranunculaceae), John Lewis (Gymnospermae), F. A. Mendonca (Nymphaceae), N. K. B. Robson (Annonaceae, Violaceae), P. Taylor (Resedaceae), G. Troupin (Menispermaceae) and H. Wild (Dilleniaceae, Berberidaceae, Cabombaceae, Capparidaceae, Bixaceae and Flacourtiaceae).

It is clear that a single publication dealing with the flowering plants of the whole of tropical Africa on the scale of the old *Flora of Tropical Africa* is too great a task for a single institution or government to undertake. Thus regional Floras have been embarked upon, based mainly on political subdivisions, and the *Flora Zambesiaca* is the most recent of these. To the north of the region covered, there is in progress the *Flora of Tropical East Africa;* to the north-west, the *Flore du Congo Belge et Ruanda Urundi;* and to the west, the *Conspectus Florae Angolensis*. To the south, work has started on a *Flora of Southern Africa*, the first part of which is nearly completed.

So little revisionary work has been done on African plants that it becomes necessary to carry out a small revision on practically every family dealt with. This is time-consuming work because, in order to arrive at the correct name to use for a species, variation must be studied throughout its entire range. The more thoroughly this is done, the more valuable will the publication be. Much of the earlier monographic work on African plants is unrealistic in that too many species are maintained on slender distinctions that are not supported by a study of the living plants in the field, or when a wider range of material has become available to the herbarium botanist. Even with the more extensive material now available, the delimitation of species limits in accordance with reality calls for good judgement. In both respects of thoroughness and judgement regarding species delimitation, the *Flora Zambesiaca* inspires confidence. Not only will botanists and field workers in the territories concerned find this a most valuable publication, but also those in adjoining territories.

One of the very few criticisms that can be made relates to the treatment of *Encephalartos vil osus* (Gaertn.) Lem., because the plants classified under this heading were separated some years ago as *E. umbeluziensis* R. A. Dyer.

L. E. Codd

Addendum

Cladophora

Cladophora isaacii *Simons*, sp. nov.

In Bothalia 7: 194 (1960) the above species was described, with a Latin diagnosis, and figured, but a type specimen was not designated. This omission is now rectified in order to validate the species.

CAPE PROVINCE.—Malmesbury District: Paternoster Bay, in mid- and upper-level pools, *Simons* in National Herbarium, Pretoria, algal collection No. 2407 (PRE, holotype).

R. H. SIMONS